

February 1998

# Mobile Radio Technology<sup>®</sup>

Technical information for paging, SMR and private wireless networks.



SMR goes cellular  
Service monitors  
Tower augmentation  
Waveform battery charging



# Keyless Entry

Keyless Entry means no more manual setup of your IFR COM-120B. Just interface the **Super Scout** Frequency Recorder to the RS232 port of the IFR COM-120B, key up any radio and the **Super Scout** captures, displays and records any frequency from 10MHz - 1.4GHz (FM Analog). At the same time the **Super Scout** automatically tunes the IFR COM-120B, or the 1200 Super S to the frequency it captures in one second.

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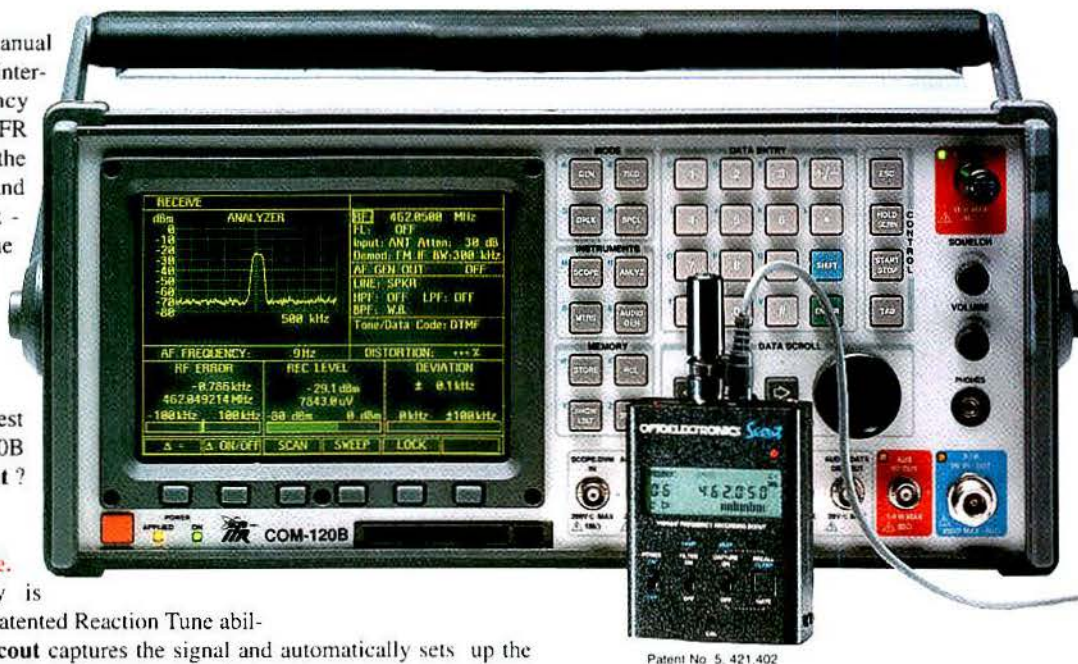
## The Super Scout can save you time.

For radios where the frequency is unknown the **Super Scout** uses its Patented Reaction Tune abilities. Key up the radio, the **Super Scout** captures the signal and automatically sets up the IFR to the radio's exact frequency, no manual setup required.

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The handheld **Super Scout** frequency recorder comes with built-in NiCad batteries, IFR COM-120B interface cable, 1200 Super S interface cable, DB32 antenna, and power supply.



Patent No. 5,421,402

## SPECIFICATIONS

**Frequency Range:** 10MHz - 1.4GHz  
**Input Amplifier:** 50 Ohm vswr <2:1  
**Sensitivity:** <5mV 30MHz - 900MHz  
**Maximum Input:** +15dBm, 50 milliwatts  
**Time Between Measurements:** 10 milliseconds  
**Display:** 10 digit LCD w/backlight

**Timebase:** 10MHz setable to +/- 1ppm  
**RF Signal Strength Bargraph:** 16 segments 3dB per segment  
**Size:** 3.7"H x 2.75"W x 1.2"D  
**Weight:** 8.5oz.  
**Battery:** Internal 4 cell AA shrink wrapped NiCad pack  
**Power:** 9-12 VDC 1 Amp wall plug adapter, supplied



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# Touch-Screen Control Console



The Vega Model C-6024 is shown with the optional expansion housing which includes an unselect audio speaker, a Clock and a Sequential paging encoder.



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The Vega Model C-6024 offers unparalleled ease of use with its touch-screen and independent switches for line selection and instant PTT. It is a unique microprocessor based multi-line, multi-format, desktop radio control console with a capacity to handle up to 24 lines! Any line may be configured for either a dedicated two to four wire radio circuit.

The touch-screen display provides feature selection with a simple touch of a finger. The flexible system offers TLM (sequential tone line modules) to allow the operator a site for transmission and DLM (dial-up access modules) which allow the operator to select a dial-up site for transmission. PLM (telephone line modules) answer or initiate a call on the PSTN.

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- ✦ Line activity indicators flash upon detecting audio
- ✦ TX ALL (simulcast) selection activates all tone lines and connected dial-up lines that are on hold
- ✦ RX ALL upon selection will monitor all unselected tone lines
- ✦ Group Select selection of TX/RX line combinations
- ✦ Frequency Selection Standard with F1-F4, expandable to F12

Contact us today to get all the details on how this flexible radio/telephone console can work for you.



## features

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*Henry J. McGinnis, P.E.*

A radical technology to meet radical changes within the wireless industry involves in-place tower enhancement.

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*Jody Steinberg and Joe Pendergrass*

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*Jim Tucker*

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*MRT staff*

Modularity and software upgrades are keys to functionality for a variety of test procedures.

**On the cover:** A technician prepares to do field testing on a remote site. *Photo courtesy of Hewlett-Packard, Liberty Lake, WA.*

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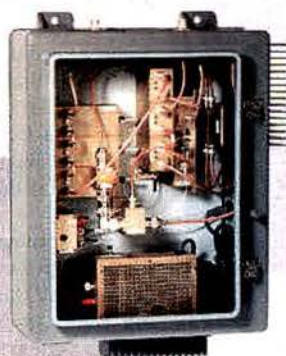
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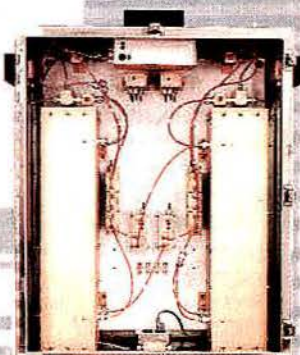
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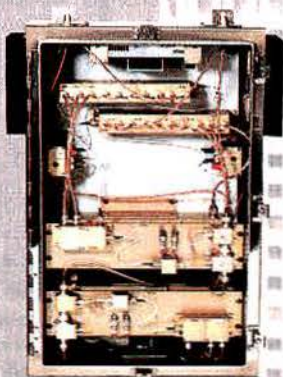
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## From 'best' to 'luckiest' to 'richest'



### Turnabout

Some specific radio frequencies are shared among many licensees in a given area. The government, which issues licenses, isn't faced with choosing among multiple applicants to use such frequencies. It has delegated the task, right or wrong, to free enterprise in the form of trade associations.

Other radio frequencies (and TV channels) are assigned to only one licensee for its exclusive use in a given location or area. Once, when the availability of these frequencies drew multiple licensees, the government used to choose the "best" applicant based on a complex set of qualifications in what was called a *comparative hearing*. When it discarded that approach, then the government would choose the "lucky" applicant at random, with a *lottery*. Currently, the government chooses the "richest" applicant with an *auction*.

(Actually, sometimes the comparative hearings chose the "richest" one, too, but the money spent went to lawyers. With auctions, the money goes to the U.S. Treasury—and lawyers. No objections have been heard from lawyers.)

I've watched this evolution in license-granting from "best" to "luckiest" to "richest" take place over the past three decades. I've been interested, and sometimes dismayed, to see how several groups of radio-frequency (RF) spectrum users have fared in this effort by the government to simplify its job (no matter how difficult it makes things for members of the public that government is supposed to serve.)

Hardly any user *wants* to bid for RF spectrum. The process is extraordinarily complicated, besides being expensive. If a user can effectively trumpet claims of

improving public safety or other benefits to the public, it can win an exemption from auctions. It also helps if the user does not resell use of the spectrum.

Take police, fire and emergency medical services, for example. Their connection with public safety is clear, and they are exempt from spectrum auctions. Take radio amateurs, for another example. Some amateur operators engage directly in projects that improve public safety and welfare. For this and other reasons, including the fact that they do not resell or otherwise make money with their spectrum access, the amateur radio service is exempt.

Take commercial and private mobile radio services (CMRS and PMRS), for example. Within CMRS, there is a growing trend for specialized mobile radio (SMR) system operators to provide communications services to public safety agencies. Regardless, they now must acquire their licenses through auction—or by purchasing rights from auction winners.

Within PMRS, efforts are under way to persuade the government to lease spectrum for many location-specific private radio purposes instead of auctioning it for use in large areas. Trade associations want to help applicants to engineer applications that are not mutually exclusive (that do not use the same frequency in the same area as other applicants) to help them to avoid auctions.

Last, but not least, consider broadcasters. With pleas as to their service to public safety (broadcasting during emergencies and disasters) and other services to the public (news and public affairs programs), broadcasters have persuaded the government to exempt them from auctions.

Until now.

On Nov. 25, 1997, the FCC proposed new rules to implement new authority to auction commercial broadcast licenses—authority given to it by Congress. The final rules may be retroactive to cover all mutually exclusive applications that will have been pending when the rules are adopted.

The political power in broadcasting is in *television*. Virtually all of the pending applications affected by the proposed rule are for *radio* stations. Radio broadcasters don't have enough clout to stop the new rules. TV broadcasters won't defend radio broadcasters.

One thing more: The proposed auctions do not affect *digital television*. The FCC is prepared to grant license applications, one to each TV station, for one additional

6MHz channel for digital television. The applications are not mutually exclusive, so they are not subject to auction.

(Attempts by broadcasters to use the digital channels for non-broadcast, revenue-generating purposes might be "taxed" at a high rate by the FCC. Their analog channels are expected to be taken back, but probably not before 2006.)

Applying auctions first to mutually exclusive applications might be the camel's nose in the tent, though. If the proposal passes, the FCC *might* take a run at TV broadcasters, especially with backing from a spectrum-money-hungry Congress that wants sales prices numbered in billions of dollars. TV broadcasters will be counting on their applications for free digital TV channels being granted before the auction camel steps all the way inside.

\* \* \*

### Transitions

We say goodbye to our senior associate editor, Ellen Jensen, who has become a staff writer for *Wireless Review*. Ellen joined us about five years ago. Her skills as a writer, editor and computer wizard have benefited readers, contributing writers, advertisers and co-workers alike. Not to mention that working with her was a joy. I know she'll impress her new friends at *Wireless Review* as much as she impressed us.

Nikki Chandler, whom Ellen recruited as editorial assistant a year ago, moves up to associate editor. A graduate of the University of Kansas, Nikki started with Intertec Publishing two years ago as an intern with *Transmission & Distribution World* magazine. The high quality of her work was obvious. Through a clever ploy that allowed us to have an early choice of job applicants last year, we were fortunate to be able to make an offer to Nikki before other Intertec magazines could. She has fulfilled our expectations, to say the least, and we congratulate her on her promotion.

Joining us as associate art director is Scott Dolash, who combines experience in print media, advertising and illustration to support the preparation of the magazine's covers, page layouts, diagrams and illustrations. You'll be seeing some of the Dolash touch before long. We say goodbye to our previous art director, Mike Knust, who has taken an assignment with two other Intertec magazines. Thanks, Mike, for a job well done.

—Don Bishop



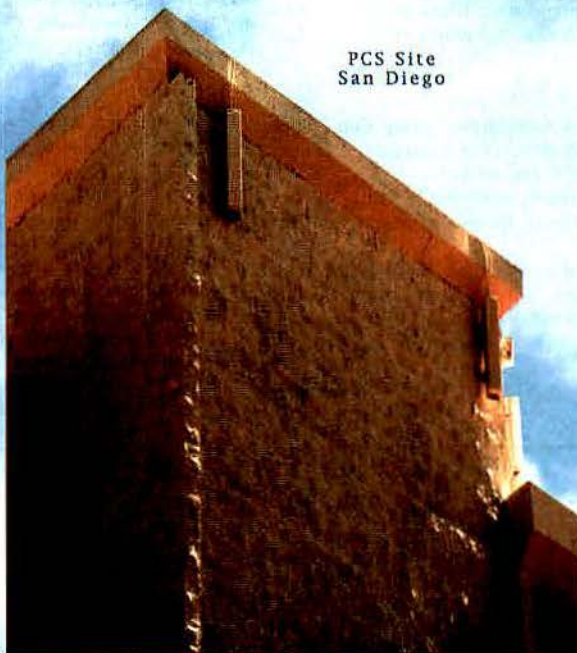
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### February

23-25—**Wireless**, sponsored by the Cellular Telecommunications Industry Association, Georgia World Congress Center, Atlanta. Contact: 212-964-7000.

### March

1-4—**ENTELEC**, sponsored by the Energy Telecommunications and Electrical Association, Marriott River Center, San Antonio, TX. Contact: 281-357-8700.

9-10—**Specialized Wireless Communications Management Conference**, sponsored by the American Mobile Telecommunications Association, Le Meridien Hotel, New Orleans. Contact: 202-331-7773.

### April

20-23—**Expo Comm/Comdex**, sponsored by E.J. Krause & Associates, McCormick Place, Chicago. Contact: 301-493-5500.

22-24—**International Wireless Communications Expo**, co-sponsored by *Mobile Radio Technology*, Las Vegas Convention Center, Las Vegas. Contact: 800-288-8606.

### May

11-14—**Telecommunications Resellers Association Spring Conference and Exhibition**, San Francisco Marriott, San Francisco. Contact: Susannah Gaylord Stoll, 202-835-9898 ext. 3009.

18-21—**Vehicular Technology Conference**, sponsored by IEEE Vehicular Technology Society, Westin Hotel, Ottawa, Canada. Contact: 908-562-3870.

20-22—**Canadian Wireless**, sponsored by the Canadian Wireless Telecommunications Association, Metro Toronto Convention Center, Toronto, Canada. Contact: 613-233-4888, ext. 102.

### June

7-11—**Supercomm**, sponsored by USTA and TIA, Georgia World Congress Center, Atlanta. Contact: 1-800-2-SUPERC.

28-July 2—**UTC National Conference & Exhibition**, sponsored by UTC, The Telecommunications Association, Hynes Convention Center, Boston. Contact: 202-872-0030.

### July

15-17—**Communications Expo/Show of the Americas**, Miami Beach Convention Center, Miami. Contact: Jackie Gonzales, 305-412-9000.

### August

9-13—**International Association of Public-Safety Communications Officials (APCO) National Conference**, Albuquerque Convention Center, Albuquerque. Contact: 904-322-2500.

### September

23-25—**Personal Communications Showcase**, sponsored by Personal Communications Industry Association, Orange County Convention Center, Orlando, FL. Contact: 703-739-0300.

23-25—**PCS Latin America**, sponsored by the Personal Communications Industry Association, Orlando, FL. Contact: Cathy Graham, 703-739-0300, ext. 3706.

### October

12-14—**Wireless Apps**, sponsored by the Cellular Telecommunications Industry Association, Bally's Las Vegas, Las Vegas. Contact: 202-785-CTIA.

14-16—**TelecomLatina**, co-sponsored by *Mobile Radio Technology*, Miami Beach Convention Center, Miami. Contact: 1-800-288-8606.

### November

11-15—**Communications Marketing Conference**, sponsored by the Communications Marketing Association, San Diego Princess Resort, San Diego. Contact: Bernie Brownson, 303-371-8182.

20—**Radio Club of America**, Communications Symposium, 89th Anniversary Dinner and Awards Presentation, New York Athletic Club, New York. Contact: Gerri Hopkins, 908-842-5070.



## Mobile Radio Technology

Technical information for paging, SMR and private wireless networks

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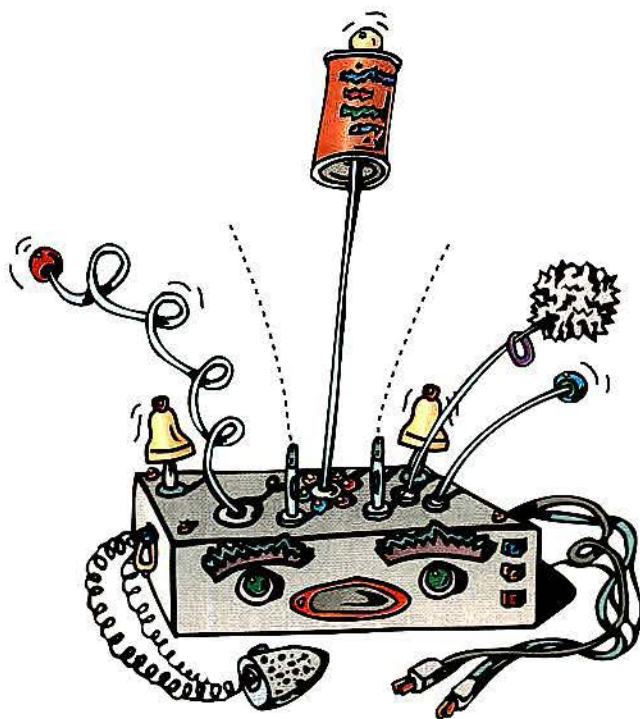
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## SWR by any other name...

By Harold Kinley, C.E.T.

No matter what you call it, SWR, or *standing wave ratio*, is an indication of the degree of match, or mismatch, of load impedance to source impedance. Generally, we use this term to indicate how well the antenna and transmission line are matched to the transmitter output. Other terms, such as forward and reflected power, reflection coefficient and return loss, are used to indicate the degree of match or mismatch as well. How are these terms interrelated? This column will explain that. Because most land mobile radio technicians are more familiar with forward and reflected power measurements, the definitions of the other terms will be based on their relationship to forward and reflected power.

### Forward and reflected power

Those who work in the land mobile radio industry typically use a directional, in-line wattmeter to measure the forward power and the reflected power at the output of a transmitter. The comparison of the forward and reflected power indicates how well the load (transmission line and antenna) is accepting the power being delivered to it by the transmitter. The higher the reflected power, the higher the degree of mismatch and the lower the efficiency of the system. Not only is the mismatch reducing efficiency, but the reflected power also triggers a *foldback protection* circuit that reduces the transmitter output power. Thus, the reflected power has a two-fold effect in reducing system efficiency.

Generally, the experienced technician uses the forward and reflected power measurements to place a *qualitative* value on the antenna system. One doesn't normally think in terms of standing wave ratio, return loss or reflection coefficient. For example, a technician may measure the forward and reflected power at the transmitter output and find that the forward power is 100W and that the reflected power is 2W. This is a high ratio of forward-to-reflected power, and so all seems to be well. The qualitative analysis has been done simply by reading the forward and reflected power and mentally noting that the forward-to-reflected power ratio is high. Forget the *quantitative* analysis, right? Yes, *maybe!*

### Effects of line loss

In the above example, the forward-to-reflected power ratio was 100/2, or 50:1.

Assuming a negligible line loss, this represents an excellent antenna match. However, suppose the line loss is 3dB. The line loss affects the forward power and the reflected power because both must travel the length of the line. Now, again suppose the forward power at the transmitter is 100W. With a 3dB line loss, the forward power at the antenna connection is 50W. Moreover, with a reflected power reading of 2W at the transmitter, the reflected power at the antenna must be 4W. Thus, the forward-to-reflected power at

---

*Transmission line loss can mask the true SWR when it is measured at the transmitter vs. measurements at the antenna..*

---

the antenna connection is actually 50:4 or 12.5:1—much worse than the 50:1 ratio found at the transmitter output. This illustrates just how transmission line loss can mask the true SWR when it is measured at the transmitter vs. measurements at the antenna. As long as you know the line loss, you can determine the true SWR at the antenna from measurements made at the transmitter. References to the previous example will be made throughout the remainder of this column.

### Return loss

If the forward and reflected power are known, the return loss can be easily determined from the formula:

$$R_L = 10 \log \frac{f}{r}$$

where  $R_L$  is return loss,  $f$  is forward power, and  $r$  is reflected power.

In the example above, the forward power measured at the transmitter was 100W, and the reflected power was 2W for an  $f/r$  ratio of 50:1. The log of 50 is about 1.7. Thus, the return loss is  $10 \times 1.7$ , or 17dB. Remember too, that the forward-to-reflected power ratio at the antenna was 12.5. Because the log of 12.5 is about 1.1, the return loss at the antenna is  $10 \times 1.1$ , or 11dB. Notice that the difference between the return loss at the transmitter and antenna is 6dB—exactly twice

the line loss. The general rule can be stated as: *the return loss at the antenna will be reduced from the return loss at the transmitter by a factor of twice the line loss.* It is important to remember that *the higher the return loss, the better the impedance match.*

### SWR

To convert forward and reflected power measurements into an equivalent SWR figure, the following formula is used:

$$S = \frac{1 + \sqrt{\frac{r}{f}}}{1 - \sqrt{\frac{r}{f}}}$$

where  $S$  is SWR,  $r$  is reflected power and  $f$  is forward power.

In the above example, the reflected power at the transmitter is 2W, and the forward power at the transmitter is 100W, so the ratio of  $r/f$  is 2/100 or 0.02. The square root of 0.02 is about 0.14. Thus, the SWR at the transmitter is:

$$S = \frac{1 + 0.14}{1 - 0.14} = \frac{1.14}{0.86} = 1.33$$

The reflected power at the antenna is 4W, and the forward power at the antenna is 50W. The SWR at the antenna is found using the same formula and is approximately equal to 1.79. Again, the line loss masks the true SWR at the antenna as seen from the transmitter end.

### Reflection coefficient

The reflection coefficient can be derived from forward and reflected power measurements by using the following formula:

$$\Gamma = \sqrt{\frac{r}{f}}$$

where  $\Gamma$  represents reflection coefficient,  $r$  is reflected power and  $f$  is forward power.

Using the example at the transmitter, the ratio of  $r/f$  would be 2/100, or 0.02.

(continued on page 50)

---

Kinley, a certified electronics technician, is regional communications manager, South Carolina Forestry Commission, Spartanburg, SC. He is a member of the Radio Club of America. He is the author of *Standard Radio Communications Manual: With Instrumentation and Testing Techniques*, which is available for direct purchase. Write to 204 Tanglewylde Drive, Spartanburg, SC 29301. Kinley's email address is [hkinley@aol.com](mailto:hkinley@aol.com).

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# Tower augmentation

*A radical technology to meet radical changes within the wireless industry involves in-place tower enhancement.*

By Henry J. McGinnis, P.E.

The wireless industry is undergoing the most radical change that I have witnessed since becoming involved with towers 40 years ago. This change is forcing tower designers, fabricators and erectors to find innovative ways of meeting the demands that are now presenting themselves to the industry as the new wave of "opportunities."

As if the challenges for the wireless industry were not enough, broadcasters are now busily engaged in finding new locations for their new digital television antennas. My company has received many requests for engineering analysis of existing structures as well as requests for quotations on new broadcast structures.

Although the engineering and fabrication requirements will represent an awesome expenditure of labor to meet the expected demands, these requirements can be accommodated. How to find enough workers to build these structures has also been a source of concern within the industry.

A radical way has been found to relieve the demand on labor to a considerable extent. Relief is achieved by way of a more efficient and less labor- and time-consuming process of in-place tower enhancement.

Having built tall towers, both self-supporting and guyed, for many years, I agree with others who have concluded that a shortage of experienced manpower may also exacerbate safety problems. Several years ago, we were called upon to construct in Cincinnati a self-

supporting tower that was 954 feet in height. Because of a short project time line, at one point 85 tower climbers were working on the project. We quickly learned that a large number of men working together on a project can be a potential hazard because they lack experience working as a team.

Despite the many manpower problems, solutions must be found that will help the operators meet their schedules for implementing their systems.

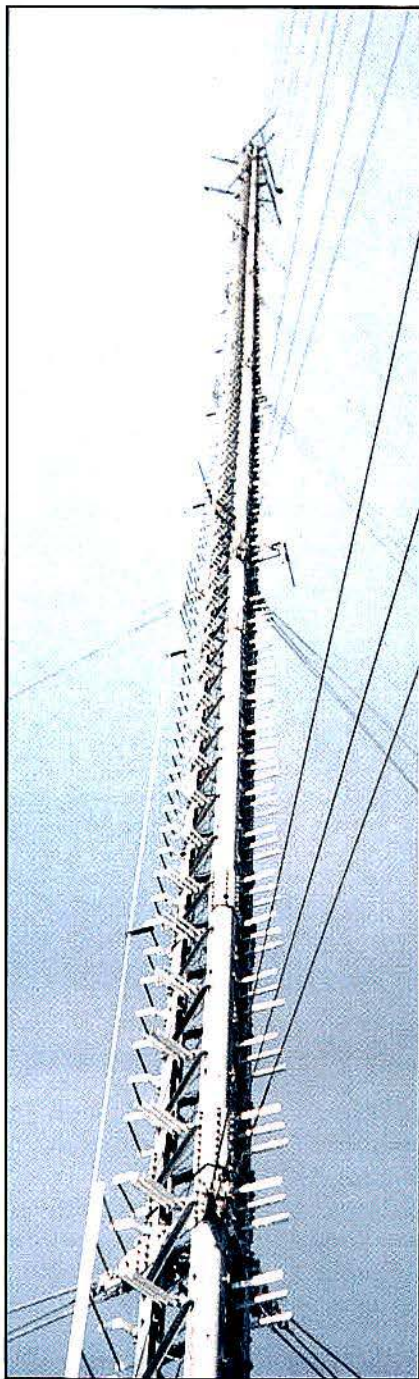
A patent-pending solution will greatly relieve many tower construction problems. Although this solution was developed to solve the needs of the wireless industry, it is also being used to relieve the tower problems of the broadcasters.

The problems associated with the broadcast industry are similar to those beginning to manifest themselves to the wireless industry. The growth of cellular and personal communications services (PCS) industries has nearly brought about a revolution within some cities, causing many local governments to declare a moratorium on new towers.

The demand for tower space has never been greater. However, analysis of existing towers reveals that most already are overloaded. The rush has begun to determine the structural status of numerous towers and, as a result, many owners are now looking for space on other new towers as well as existing towers.

An axiom in the tower business is "Towers attract antennas" and, owning several towers myself, I can attest to the truth of that statement. It also has been said, "Necessity is the mother of invention." I know this to be true also. One tower in our inventory was located in a popular location and reached the point of overload quickly. In fact, the potential for continued loading was still growing, and we determined that something innovative needed to be done to bring the tower into compliance with the Electronics

**Photo 1.** A tower in its completed, augmented state. The antenna mounts are standing a sufficient distance away from the tower face to allow passage of the multitude of coax up the face of the tower. Note the presence of the triple guy line set, consisting of the two augmentation guy lines along with the original, relocated guy line. The corner mounted climbing steps with associated anti-fall device are visible on the left side of the tower.



McGinnis is president of Landmark Tower, Fort Worth, TX, 800-438-6244.



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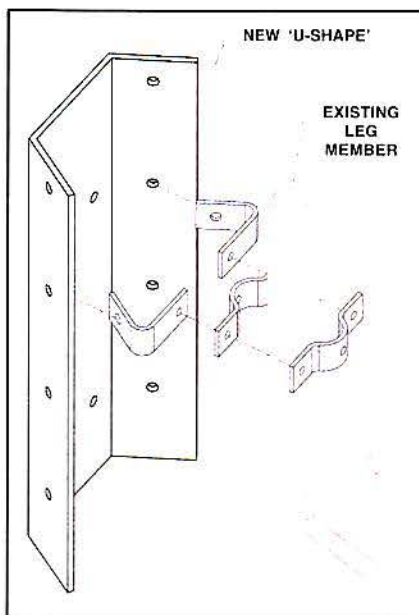


Figure 1. The 'U-shape' with the formed leg member around the existing leg member constructs 'a tower around a tower.'

Industries Association code requirements.

For many years, we have analyzed towers of all shapes, sizes and descrip-

tions and have designed and implemented "fixes" to bring structures into code. However, we had never had a requirement where we needed to bring a structure to a capacity of *four to five times* its original loading.

At first, we could see no way in which this could be accomplished. The task seemed impossible, and we sought to build a new tower. We quickly learned that the land was not available, and even if it were to become available, the chance of obtaining a building permit was at best, "slim to none."

Our next thought was to construct a new tower beside the existing tower. Our idea was again frustrated by the fact that the space was quite simply too small. The original tower was less than 50% guyed and it stood immediately adjacent to an interstate highway. The tower topped out at 500 feet, and as such, should it ever collapse, it could conceivably fall across the highway. The fact that guy lines would have to be interlaced only added to the complexity and increased the possibility of collapsing an already overloaded structure. Additionally—the tower being greatly loaded—the prospect of moving

existing transmission lines and antennas onto an adjacent structure posed a staggering cost. This process was not only expensive, but it held a high potential for damage to antennas and transmission lines, especially those that had become weathered.

While all of the above options were considered and rejected for various reasons, the pressure was intensifying daily. The facts that the structure was already heavily loaded, and that new customers were clamoring daily to be allowed on the structure, only intensified the complexity of the problems.

For many years, my company has constructed its guyed and self-supporting towers with a "U-shaped" member. Because many towers are quite large, the practice of "nesting" several of these shapes into ever-increasing thicknesses of composite members solves any loading problem. For example, one proposed design of a 1,149-foot, self-supporting tower for the Far East resulted in leg sections 24" x 24" x 24" by 3 inches thick. This required four layers of U-shapes nested and stitch-bolted together.

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**Photo 2.** The base portion of a small 18-inch face tower on which the augmentation process has been completed. The massive augmented mast foundation is an indication of the load this structure is now prepared to carry. Also, this photo shows the coaxial cable mounting members extending outward from the tower face, as shown in Figure 2.

We would simply design the required "U" shape and place the formed leg member around the existing leg member in such a way as to construct "a tower around a tower," as shown in Figure 1 on page 12.

Once on the trail of this new solution, other factors began to fall rapidly into place. The new leg and lacing members could be placed in a manner that would

shield the existing members from wind load. In so doing, the tower wind loading to be considered would be greatly reduced. The best part of the solution resulted from a structural benefit that I will refer to as the "Ad<sup>2</sup>" effect. All structural engineers will quickly recognize what I am referring to here; but, for those who practice in other disciplines I will describe the augmented benefits by saying that "The total of the structural benefits of the composite shape is much greater than the sum of the individual parts." When one considers the composite load-carrying capacity of the "built-up" cross section (consisting of the old leg working in conjunction with the new leg), the resulting cross-section structural capacities increase significantly.

The actual benefit of this procedure is enhanced because the contribution to the composite cross section may be factored to allow for deficiencies in the existing leg member, due to deterioration. Many of our tower inspectors have found towers with pipe legs that have rusted from the inside, thus rendering them dangerously close to collapse. In cases like these, the existing leg is determined to contribute nothing to the strength of the cross section, and the new U-shaped member is increased in size or thickness to carry the extra load.

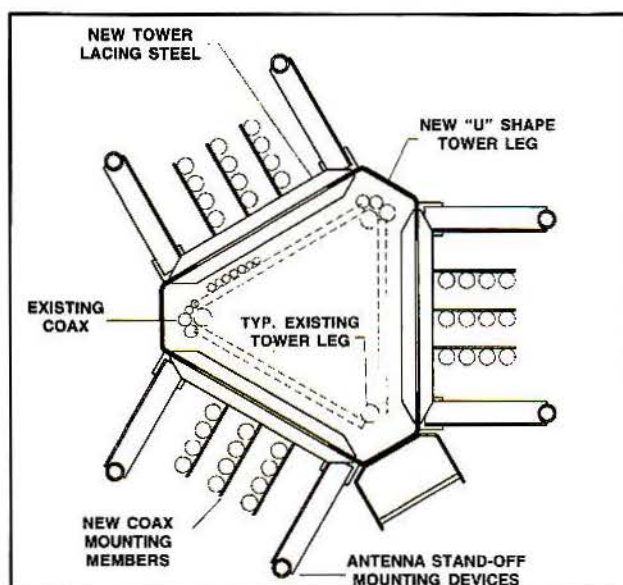
The old and new leg members are clamped together as frequently as needed to effect the transfer of forces to ensure that the legs will work together in the appropriate sharing of forces. However, the clamps are not brought to a final

tightened condition until the tower is completely stacked. The new tower compresses, due to added weight, as the new tower is stacked. To avoid placing additional loading on the old tower, because of this shortening effect, the clamps are finally torqued only after the new steel is completely in place.

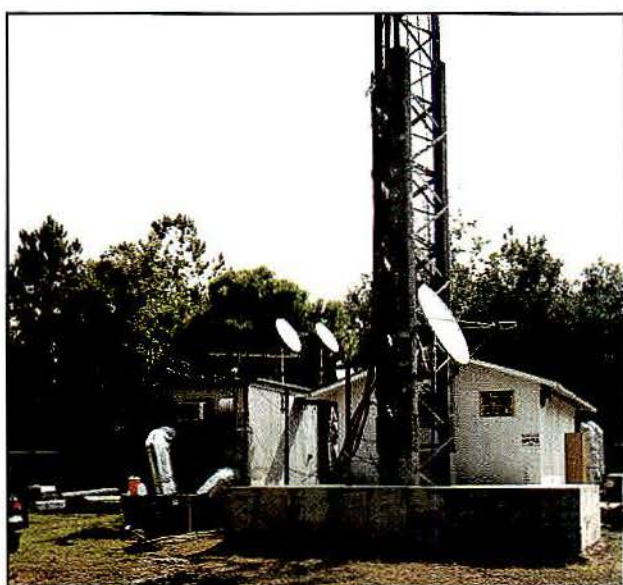
Because the objective is to completely shield all existing members with new members to minimize wind loading, the new steel is detailed with splice plates of differing gap lengths that vary the gap between successive vertical sections. The compressive effect mentioned above will always allow the proper alignment of the shear bracing of the new tower lacing steel to coincide with the existing tower lacing members, thus always maintaining proper shielding.

With respect to the clamping mechanism, although the lightweight clamp shown on Figure 1 is usually sufficient for small towers, the clamp that interconnects large members would require fabrication from heavy structural plate to apply sufficient clamping strength to effect the structural transfer.

In Figure 2, below left, the original tower is represented by the dotted lines. The broken circles forming the triangular cross section represent the existing tower. The smaller circles represent existing transmission lines. Because the new U-shaped legs must be open to fit around the flanged connection of the existing legs, the coaxial transmission lines will be moved out onto the face at these flange intersections. In most cases,



**Figure 2.** The original tower is represented by dotted lines, with broken circles forming the triangular cross-section. The smaller circles represent existing transmission lines.



**Photo 3.** At the top, the slender lightweight structure is protruding from the massive augmentation steel. The massive foundation at the base shows the tremendous load that this tower will carry.



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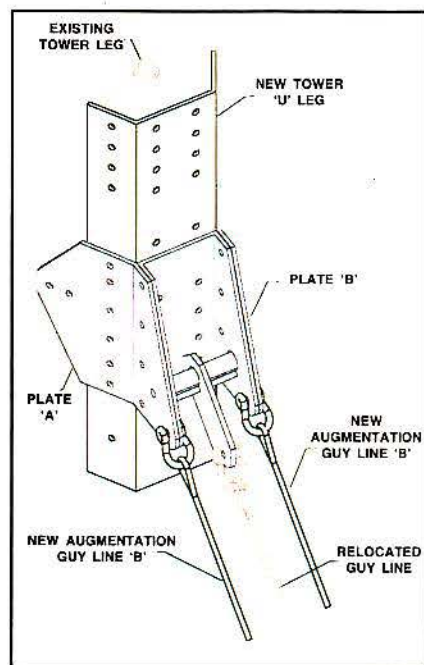


Figure 3. The augmentation tower steel is stacked to 2 to 5 feet below existing guy line elevation. Then plates A and B are installed along with the associated hardware and steel. The new augmenting guy lines are attached to the plates A and B.

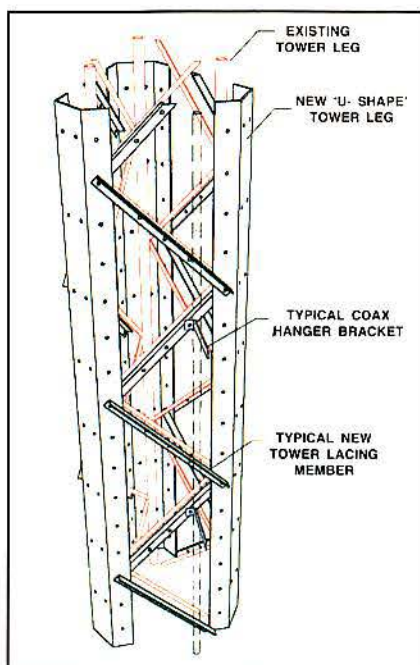
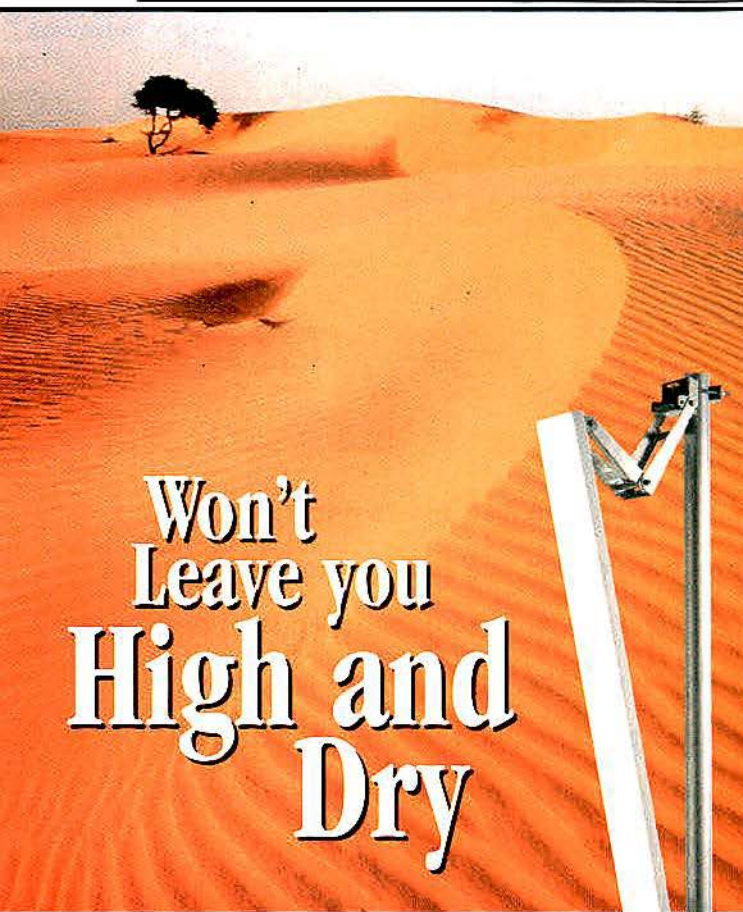


Figure 4. Illustration of placement of coax hangers and the new tower lacing members. The existing tower structure appears in red.

the transmission lines are already on the tower faces, and the new tower steel is simply configured to pass over the transmission lines, which remain undisturbed. In some cases, it is desirable to configure the new augmentation steel much closer to the existing steel. This is accomplished by loosening the coaxial transmission lines from the existing tower (over a distance of approximately 40 feet above and below the panel where the new steel is being worked) and sliding the new lacing member in behind the coax. The new lacing steel is thus connected to the tower legs, and the coax is fastened to the new steel as work progresses upward.

Figure 2 also shows the means by which a large quantity of new coax is mounted to the tower. Because many of the towers to be augmented have narrow face widths, it has been necessary to use small bars that extend perpendicular to the tower face. This gains sufficient space to allow for the large quantity of coaxial lines to be deployed. The bars can be configured to use the popular snap-in coax mounting devices or any other mounting device requested by the



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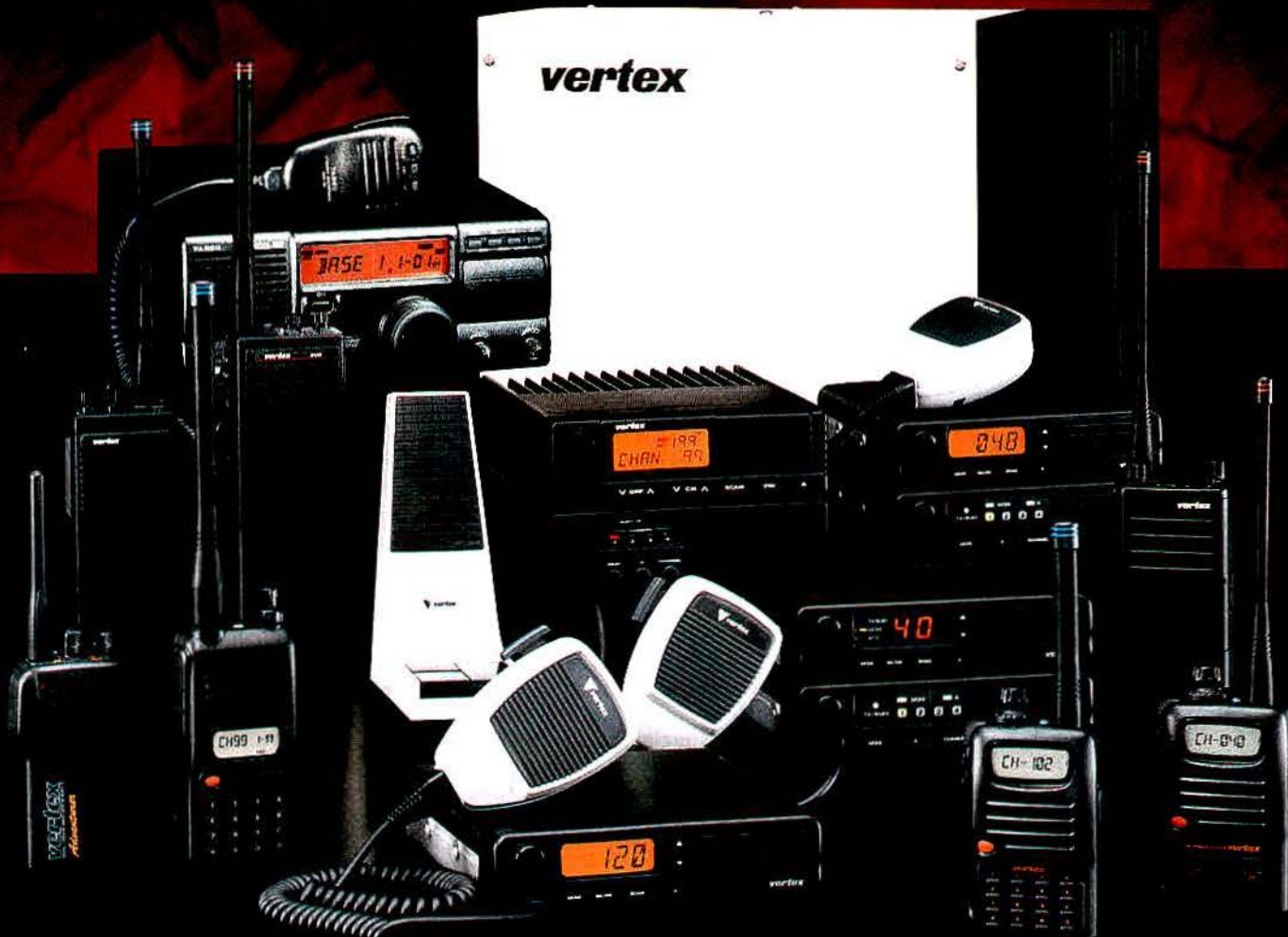
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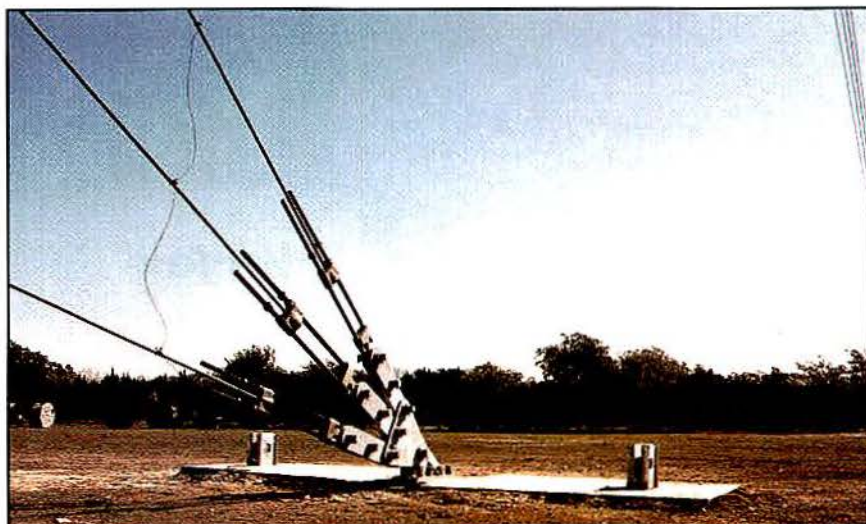
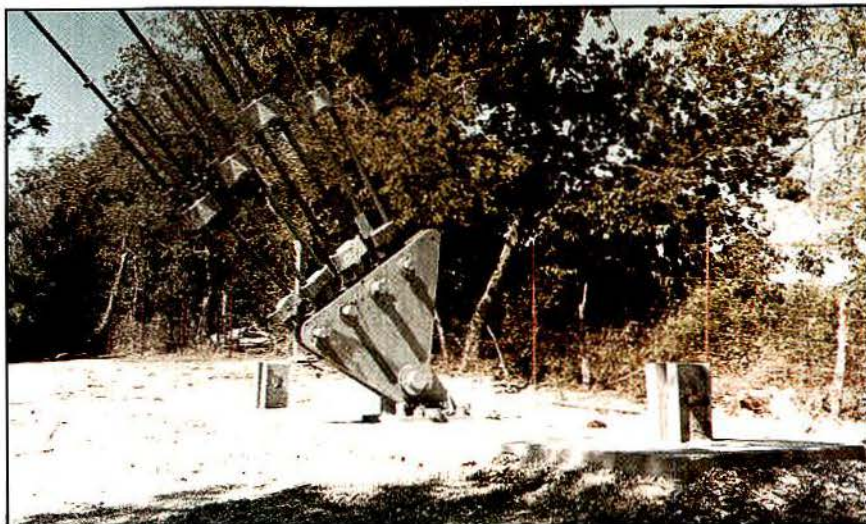
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Photos 4 and 5. Augmentation can be used on larger towers with great loads. These guys support a 1,535-foot broadcast tower. Note the two sets of structural channels flanking the fan plates.

customer. Because most waveguide is mounted inside broadcasting structures, the problem is eliminated in these cases.

On towers with small face-widths, a new climbing device is configured on the heel of the outside corner surface of the new U-shaped leg because, in most cases, the coax will be configured so closely and densely that climbing the tower by any other means will be impossible. (See Photo 2 on page 14.)

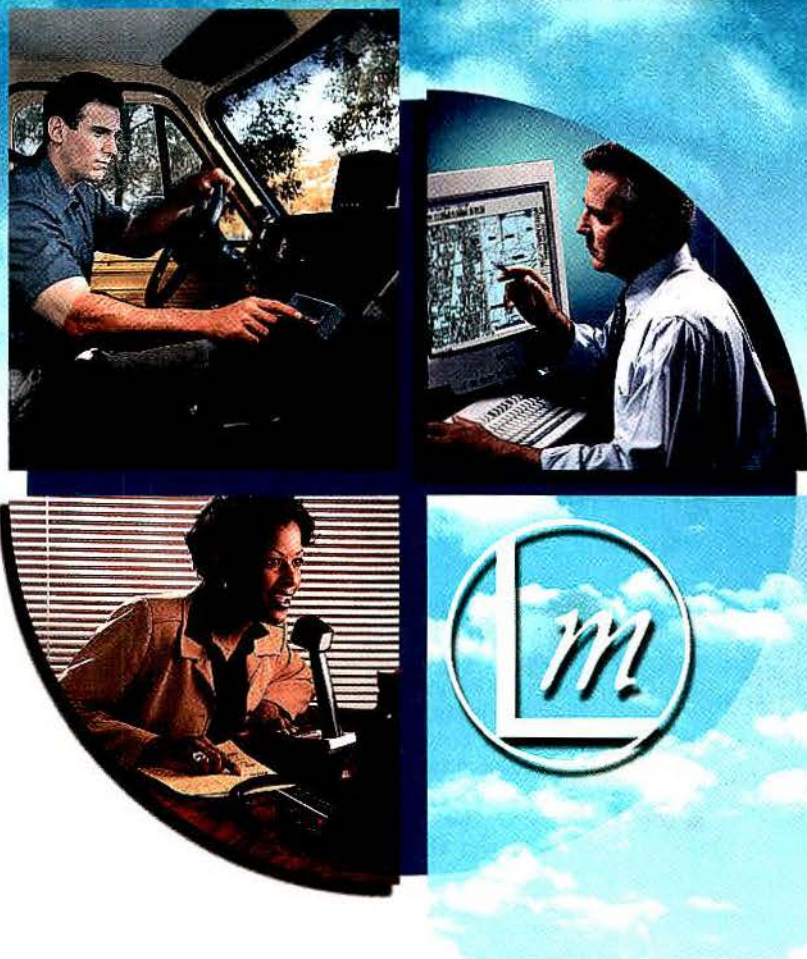
The "antenna stand off" mounting devices are configured to facilitate extending the existing antenna mounting structures at a sufficient distance from the tower face to clear the stack of new coaxial lines running up the faces of the tower. The new stand-off brackets are configured to allow the existing antenna mounting arm simply to be unbolted from the existing tower leg and swung outward from the tower face while sus-

pended by a rope or a cable sling from above. The new tower steel is passed behind the mounting arm, and it is attached to its new stand-off bracket with the same hardware originally used. The new antennas to be mounted to the tower also use the antenna stand-off brackets to allow clear passage of the coaxial lines up the face of the tower.

The augmentation tower steel is stacked to an elevation about 2 to 5 feet below existing guy line elevation. At this point, plates A and B are installed along with the associated hardware and steel as shown in Figure 3 on page 16. The new augmenting guy lines are attached to the plates A and B. Once the guy lines A and B are attached to their new augmentation footings, the lines are tensioned to ensure the vertical alignment of the new construction to this elevation. Once this is done, the original existing guy line is



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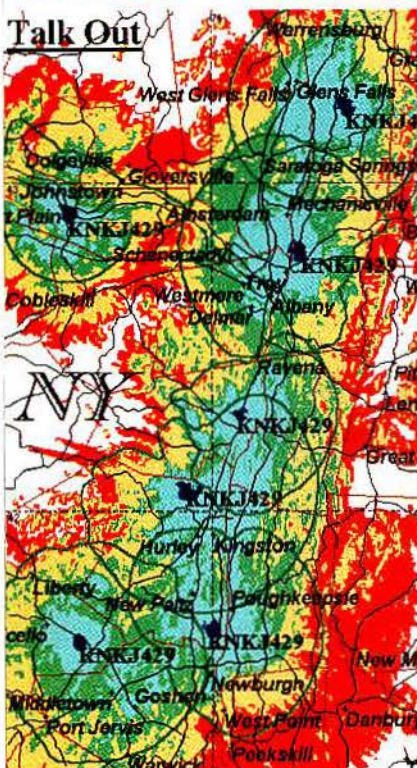
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Photo 6. Two sets of structural channels are embedded within the anchor case. The channels will accept fan plates to which the augmentation guy lines will be attached.

removed from the original mounting bracket and placed on the new hardware provided below, as shown in Figure 3. This existing guy line is then retensioned on the existing footing, and the stacking process is continued.

Because poor soils usually require extreme measures to sufficiently anchor the guy lines, we have been conducting research with Foresight Products, Commerce City, CO, regarding its "Manta Ray" anchor system. We have developed a system of "ganging" several of these anchors together to develop fairly high load capacities. It is expected that for smaller towers, this system will function well in cohesive soils.

#### Summary

There are many advantages to be realized by the augmentation system:

- Towers that are badly deteriorated may be kept in service.

- Payload capacities of existing towers can be increased by many times the original capacity.

- In most cases, the customer does not have to be taken off the air, even for a very short duration.

- In many cases, a building permit for augmentation is not required.

- There is no requirement for additional land.

- The method is simple and safe because no gin pole is required. The lift line is rigged from an appropriate point on the existing tower.

- At no time is the original or new structure vulnerable.

- Should an increase in height be required, a gin pole is installed as the process reaches the height of the original structure, and the process simply continues, with the new steel, to the desired height.

- A computer model established the condition of the augmented tower. This model can be used to monitor and maintain future management of the structure.

- The overall cost of augmentation is usually considerably less than going through the process of land acquisition, permitting, construction and landscaping for a new structure.

- The augmentation is done in a manner to allow for future "augmentation of the augmentation."

- Only a portion of an affected structure needs be augmented to achieve a desired elevation.

- Dual guying provides a system of redundancy that allows safe simple future maintenance of both tower and footings.

- A simple system of obtaining field data allows an accurate computer model to be configured.

- Erectors may work directly with their customers in selling and installing the tower augmentation kits.

- Should erectors desire, training can be provided for their crews, including time-saving techniques for kit installations.

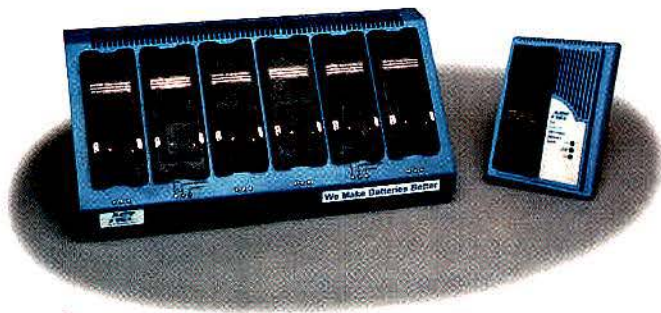


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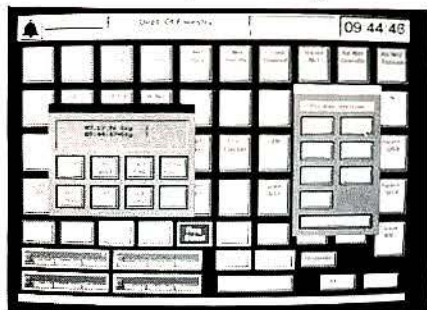
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## Tower planning and management for local governments

By Brett Nichols  
and Paul Schneider

With continual auctioning of spectrum by the FCC, mobile telephony companies and investors have new opportunities to provide wireless services to the general public.

To facilitate the installation of wireless systems, carriers must find suitable structures to support the antennas and equipment necessary to operate a wireless system. As a result, new communications towers are being constructed across the country at a tremendous rate. Tower proliferation is becoming an increasing concern to municipalities and to the general public.

Municipalities can benefit from proper handling of this situation. The use of consultants to the wireless industry for radio frequency (RF) engineering design and program management (PM) of systems implementation can be a proactive step in assisting municipalities in facilitating the planning and construction of new towers within their jurisdiction. Assistance can be provided through education, feasibility studies, tower development, tower management and financing. Several steps can be used in implementing a program for municipal jurisdictions.

The planning and feasibility process begins with the municipality identifying available parcels of land suitable for new tower construction. For example, an RF engineering team can use propagation tools and measurement test equipment to validate the site locations and to analyze existing carriers' signal strengths. Site locations meeting RF parameters can be reviewed for capital requirements. This cost assessment would be conducted through a detailed analysis of soils conditions, tower capacity requirements, structure type, and wind loading requirements. If the feasibility proves positive, there are several options for the municipality, ranging from consulting services for municipal tower ownership, working with regional carriers to build on selected location, or building and managing

each tower location. At this point consultants typically engage the municipality contractually to lease municipal lands for tower ownership.

There are numerous benefits to the municipality for strategic tower deployment planning. Proactive movement by the municipality will facilitate the implementation of wireless service and satisfy the general public as a whole with advanced wireless services and specific tower placement. This process will reduce or completely eliminate tower proliferation. Although not any one portfolio of towers will satisfy all wireless designs, this process will cover more than 50%. Strategic tower placement will also generate revenue for municipalities. As consideration for land usage, tenants will pay rent on each parcel of land leased. In addition, arrangements can be made for local government installations for fire and police department wireless dispatch. In some cases, the consultants can be retained to manage the towers. Tower management includes facilitating co-location rights, interference protection, monitoring and controlling site access, maintenance, and negotiating with future tenants.

This type of arrangement benefits not only the municipality but the wireless service providers as well. With competition increasing for wireless services, speed to market is critical. One common delay in system implementation is zoning resolution. Jurisdictional approval for new towers can delay a site for more than six months—sometimes indefinitely. Typically, in most jurisdictions, co-location on existing towers does not require jurisdictional approval and reduces overall timelines. Also, if the carrier is aware of the existing tower, it will incorporate the site in its initial design as an anchor tenant. This process provides carriers speed to market and favorable reception by the local government and the public. Otherwise, disputes can arise from the public that put both the municipality and the carrier in an awkward position.

A well-managed municipal wireless deployment strategy helps governments develop new services within the community, and generate revenue for the jurisdiction.

Nichols and Schneider are vice president general manager, respectively, for program development with LCC International, McLean, VA, which provides RF engineering and consulting services.





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# Charger technology uses improved ion balancing

*A new algorithm for recharging waveforms leads to short duty times and decreased deterioration of the electrochemical processes in batteries.*

By Jody Steinberg and Joe Pendergrass

Today, even the smallest company can conduct global business with the right equipment. Laptop computers and cellular phones, two-way radios and hand-held scanning devices are no longer luxuries for top executives or mega-companies—they are required equipment, enabling workers at every level to produce efficiently. However, this mobile equipment, while becoming more powerful every day, still has an Achilles' heel—undependable battery performance.

Batteries designed to power mobile equipment seldom perform to manufacturers' standards after the first few uses—a weakness that can render the best business tools in the world useless. Because of this increased use of mobile technology, rechargeable batteries have accounted for a larger share of the battery market in recent years and have become a multibillion-dollar business.

Batteries are a *dependent* commodity—useless without chargers. Many chargers are so inefficient, they actually destroy the batteries slowly, or contribute to performance problems that have become the

nemesis of portable convenience.

Original equipment manufacturers (OEMs) want to replace their nickel cadmium (NiCd) batteries with a lighter, higher-capacity, and most importantly, reliable battery. Battery research in recent years has developed nickel metal hydride (NiMH) batteries, lithium-ion (Li-ion) batteries and a few other smaller

---

*With proper handling and charging, NiCd batteries can continue their role as the affordable, rechargeable workhorse.*

---

players. However, these improvements are not without drawbacks—high costs, short cycle life, limited power capabilities and, with NiMH, a memory effect of its own. In spite of the emergence of these new battery types offering increased power density, NiCd batteries still hold the lion's share of the market and will continue to do so because of cost, poten-

tial life cycles and proven performance. Although it is true that they can demonstrate problems such as memory effect—which reduces charge capacity and cycle life with proper handling and charging—NiCd batteries can continue their role as the affordable, rechargeable workhorse.

Ironically, even though OEMs improve and release new products every year and billions are spent on battery research, little attention is being paid to the charger. This "little companion box" that comes with these products may be the cause, and eventually the solution, to many of these battery shortcomings.

A patented dynamic electrochemical wavelength (DEW) charging technology improves battery performance, recovers lost capacity and turns cumbersome battery-care procedures into a simple, one-step process.

For professional users of all portable products, dependable battery power is critical to staying on the job. A suitable charger was developed in response to the frustrations heard from the field. Public safety, transportation, government, military and utilities professionals, service and field personnel alike have asked for a solution to battery woes that hinder productivity and compromise safety. The charger was designed to provide a new technology that not only charges more efficiently, and thus faster, than other products, but that provides a dependable, maximum-capacity charge every time while extending battery life.

The standard OEM or consumer-priced battery charger is a "constant-current trickle charger." A trickle charger operates by delivering a steady, low-level,

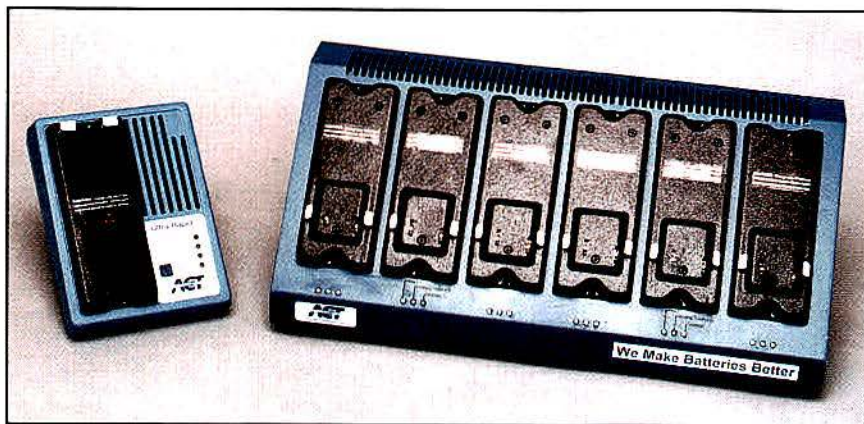


Photo 1. Multiple bay charging stations.

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Steinberg is communications manager, and Pendergrass is vice president of engineering for Advanced Charger Technology, Norcross, GA. The company's product, the Activator battery charger, uses the dynamic electrochemical wavelength technology described in the article.





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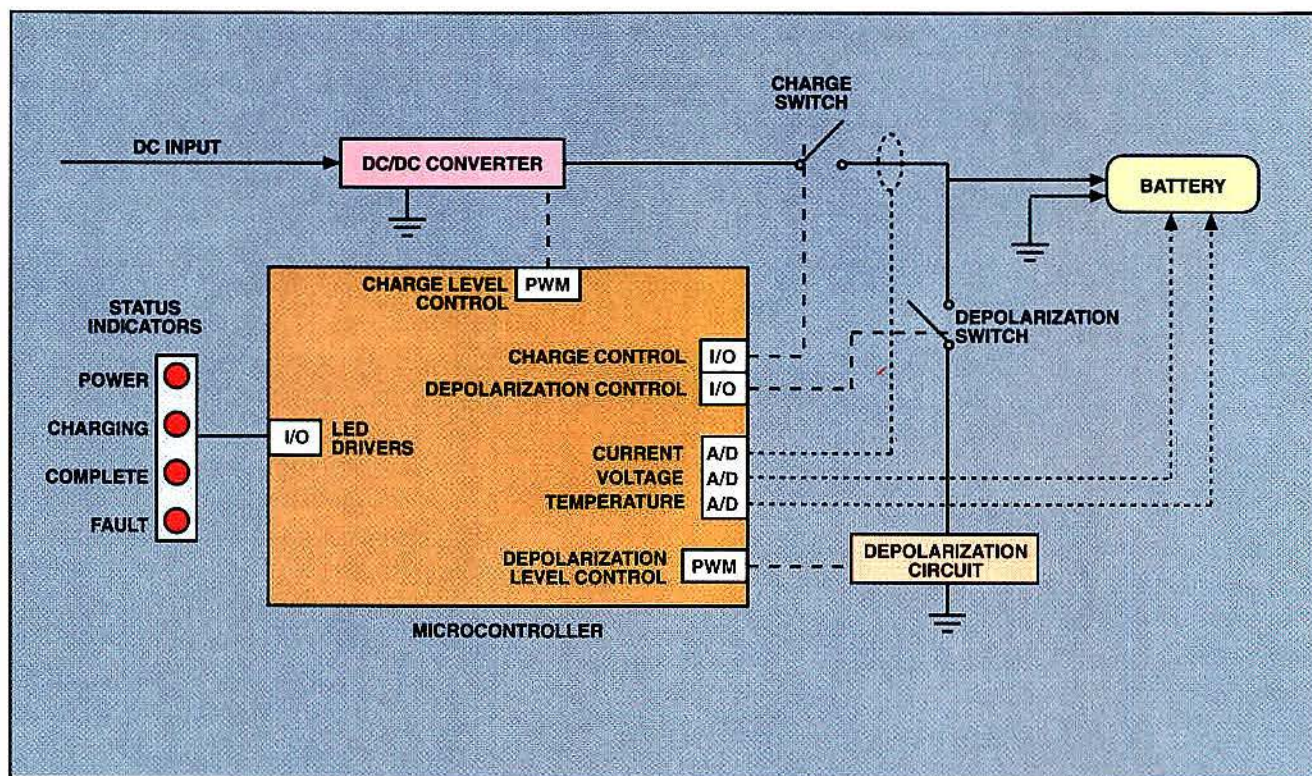


Figure 1. The rapid charging station employs a microcontroller to determine the condition of the battery.

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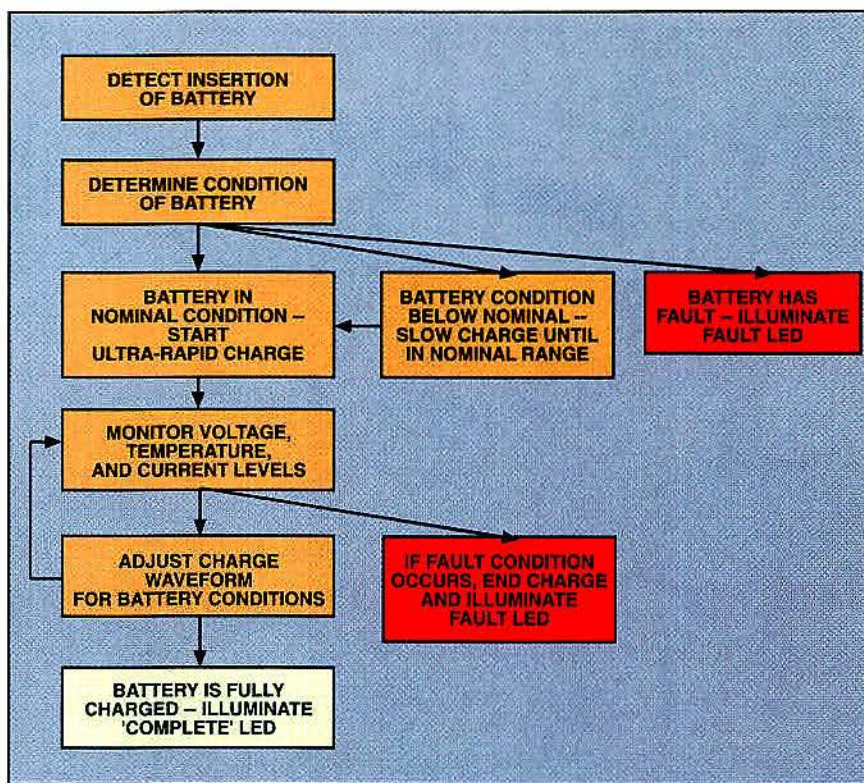


Figure 2. Battery charging logic flow chart.

positive current for as long as it is connected to a power supply. Ions are generated at one electrode in a battery cell and must move to the other electrode. If the current is sustained over an extended period, the ions concentrate on one side and create polarization, which causes heat generation, inadequate charging capacity and a shorter life for the battery.

These slow, "overnight chargers" rely on the user to stop them when the battery has reached its maximum capacity. They generally charge a battery fully in about 10 hours. They are inexpensive and simple to design, but they do not optimize the performance of the battery. In fact, they actually contribute to premature disposal of the batteries. The low charge rate allows the chemical reactions to be localized on the electrode surface, leading to dendrite growth. There is a high likelihood of overcharging and, in the case of NiCd and NiMH, voltage depression, or "memory effect."

Memory effect is the great "imposter" that causes the premature demise of batteries. When NiCd batteries are recharged before they are fully discharged, electrodes *passivate*, decreasing the ability of the cells to accept a charge. When a battery is repeatedly charged without being fully discharged, operating time and performance deteriorate, and it appears to die

before its time. Most electronic equipment will stop operating before the battery can reach a low enough per-cell voltage to recover the voltage depression, so few batteries are fully discharged before they are recharged. This practice and the standard OEM constant-current chargers combine to sabotage NiCd and NiMH battery performance.

Most OEM-upgrade fast chargers operate by *increasing* the constant current rate, charging the battery in only two or three hours. They either have rudimentary circuitry that terminates when the battery is fully charged, or they decrease the charge current when the battery reaches a certain voltage, usually about 80%-90% charged. However, charging at a high constant-current rate ignores the electrochemical process within the battery, which, over time, causes significant deterioration, similar or worse than that caused by the trickle charger. The result is reduced capacity with each charge, untimely wear-down and an abbreviated life cycle for the battery.

Pulse-charging, introduced in the 1960s, was the first improvement to the constant-current trickle charge. Pulse-charging operates on the principle of surging power into the battery in pulses of electrical current. One-second pulses of power are interspersed with rest periods,



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lasting a fraction of a second. Interrupting the pulse current gives ions a chance to diffuse and distribute more evenly throughout the battery and return to normal levels routinely, thus reducing some of the negative effects of trickle charging. Although it was developed to address the chemical process of batteries, pulse charging still ignores the chemical reaction and physical phenomenon taking place in the battery. It provides short-term

fixes, i.e., charged batteries, but the costs are heavy—shortened battery life and shorter charged cycles, which translates into inadequate power to support equipment for the recommended duration.

The second generation of pulse-charging emerged in the 1970s to counter the problem of recharging batteries that aren't fully discharged. This method, used only in selected commercial chargers, augments the rest period by adding a short

negative discharge pulse (depole pulse) interspersed with the positive charging pulses. The depole pulse is 2.5 times as strong as the charge pulse and is followed by another rest period. This method seemed to solve some of the problems of traditional charging. Batteries return to balance more quickly, speeding up charging rates to as quick as one hour for a 700mAh battery and improving performance. The shortcoming to this approach is that the ion transport problem gets progressively worse as the battery is charged. The single-discharge-pulse method can only gain limited information about the state of the battery, and the charge current cannot exceed the level that is acceptable at the end of the charge, when conditions are most limiting.

#### A new algorithm

Even those OEM chargers that perform a discharge function do not discharge the voltage low enough to recapture all the hidden capacity lost to memory effect. However, a new algorithm, discovered by Yury Podrazhansky and patented by Advanced Charger Technology, discharges to the lowest possible level to return hidden memory capacity. Podrazhansky, a Russian immigrant with a background in electrical and radio frequency engineering, was busy searching for a solution to the problems plaguing his rechargeable batteries when he developed the DEW technology.

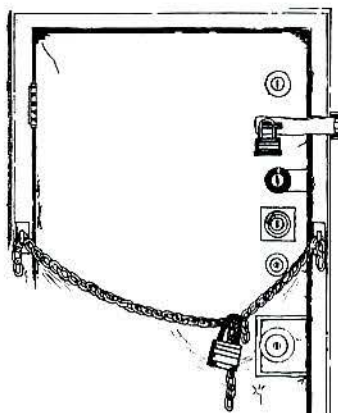
Podrazhansky, Advanced Charger Technology's vice president of research, discovered that the negative discharge in pulse charging can cause negative effects in the reverse direction. Single, high-magnitude negative pulses cause ion transportation problems in the negative direction as well as excessive discharge of the battery, which increases charge time.

Podrazhansky found that applying even shorter, multiple, negative pulses with a higher magnitude eliminates charging problems and actually benefits battery chemistries. The higher-magnitude discharge pulses are inherently focused in the area of dendrites and help to remove them. When allowed to build up, dendrites can short-circuit a battery's electrodes. The brief, high currents rapidly balance the ion concentration and improve the crystalline structure of the electrodes. In NiCd batteries, the currents momentarily pull the battery voltage down, resulting in a reversal of voltage depression. The improved balancing of ion concentration leads to an efficient charge process that enables a higher charge current, yielding the shortest charge times possible and actually conditioning batteries as they are

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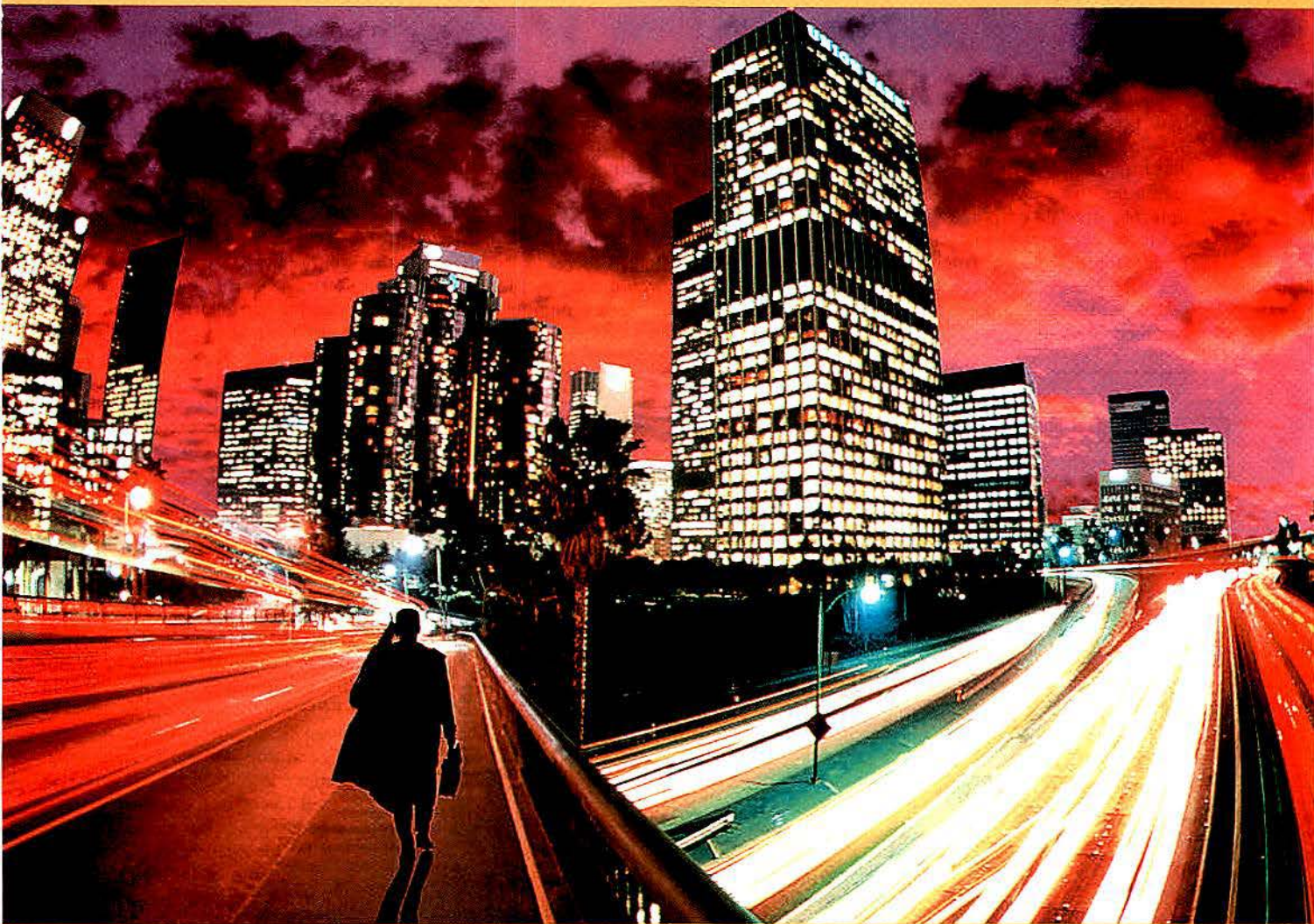


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charged, eliminating the need to discharge first. Podrazhansky used his discovery to develop DEW technology—a charging waveform that intersperses variable length positive charging waves with multiple negative discharge waves.

Since receiving his first patent, Podrazhansky has refined the DEW charging process [or algorithm], and, together with ACT, has developed it for commercial availability. The commercial

DEW chargers come in single- and six-bay versions as shown in Photo 1 on page 24. The charge rate is faster than other fast chargers—about 30 minutes per 1,000mAh. That is about 10 times faster than a conventional trickle charger. Although one might think that with such fast charging times, chemical problems in the battery would increase, quite the opposite is true. Using microcontroller intelligence, the charger monitors each

individual battery and provides the appropriate charging characteristics for that battery.

#### How the charger works

The charger is a smart charger that provides the benefits of a conditioner. A microcontroller, as shown in Figure 1 on page 26, manages the charging process, which begins automatically when the user inserts the battery. After the battery is installed, the microcontroller determines the condition of the battery. Based on this condition, different processes can transpire, as shown in Figure 2 on page 28.

If the battery is in nominal condition—used and discharged but otherwise fine—the charger will switch straight into rapid charge mode, conditioning the battery as it charges. The microcontroller monitors voltage and current levels as the battery is being charged, adjusting the charging algorithm to condition the battery throughout the entire process. When charging is complete, a light-emitting diode (LED) illuminates, and the charger halts automatically, delivering the battery in peak condition without overcharging. If the battery is left on the charger, the charger will maintain the battery using a proprietary process. This allows batteries to be left on the charger indefinitely.

At the beginning of the charging process, if the charger detects that the battery condition is below nominal, it will test the battery and, if necessary, slow the charge until the battery is brought into nominal range and then resume rapid charging. When a new or badly abused battery is charged for the first time, it will be reformatted by the technology.

#### Battery chemistries

The sealed lead-acid (SLA) battery was the only game in town for more than a century. It was joined by the NiCd battery in the 1950s, and the two types still dominate the rechargeable market today. Research into new chemistries has developed NiMH, Li-ion, alkaline magnesium and zinc air batteries—all designed to give the consumer lighter-weight, longer-lasting cells. While serving their intended purpose of better performance, each of these new chemistries has its own advantages and disadvantages, and all operate on the same basic electrochemical process.

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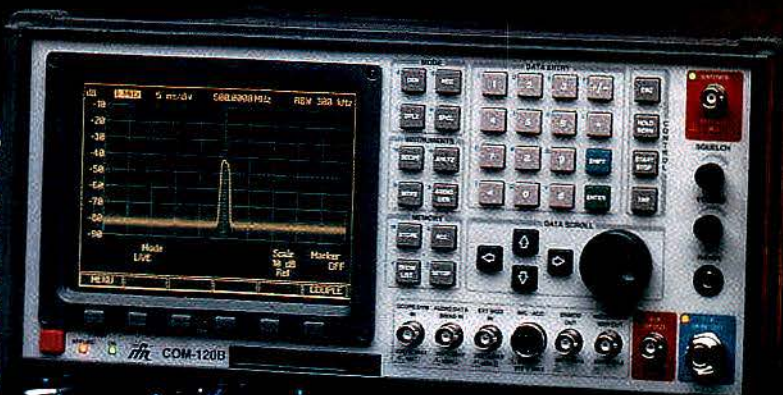
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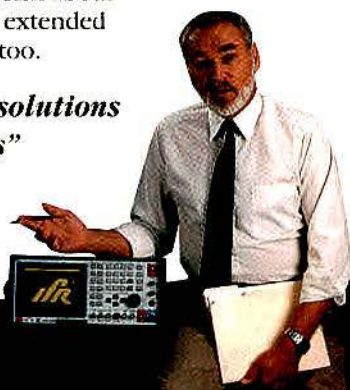
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by an influx of electrons from an external source. Chargers provide these electrons. When they are released, electricity is generated, excess electrons are consumed and the battery slowly deteriorates to its natural state.

A battery consists of two electrodes, a negative anode and a positive cathode, with a porous separator in between. If the electrodes contact each other, the battery shorts out and becomes useless.

The electrodes and separator exist in an electrolyte solution that has an initial concentration of ions that supports the chemical reaction rate and provides a medium for ion transport.

As a battery is discharged, its internal electrochemical process results in the transfer of ions from one electrode to the other through the electrolyte. When the battery is charged, the process is reversed, and the ions travel in the opposite

direction. During this electrochemical process, each electrode goes through a chemical reaction that generates these ions at one electrode and consumes them at the opposite electrode.

How well this process is carried out has an effect on the overall performance of the battery. The chemical reaction rate at the electrode that is consuming ions is limited by the concentration of the ions at its surface. This concentration is related to how well the ions are able to move through the supporting electrolyte and separator. If the ion concentration across the surface of an electrode is uneven, the chemical reaction rate will not be uniform, leading to the development of dendrites—outgrowths of material from the electrode. Unchecked, dendrites can eventually grow through the separator, and the electrodes can come into contact, shorting out the battery. The charger addresses these problems by preventing dendrite buildup and maintaining even ion concentration.

Another factor in the performance of a battery centers on the crystal structure of its electrodes. A fine-grain structure reduces internal resistance and increases surface area. Under extended, low-current conditions, the slower chemical reaction rates can cause the size of the crystals to increase, reducing the surface area per unit of volume and causing a potential drop in overall battery capacity and an increase in internal resistance. This increase in internal resistance will result in lower battery capacity.

For ideal rechargeable battery performance, the charging regime should work with the electrochemical process to ensure a high uniform crystal structure at the electrode. Ion transfer should be smooth, with minimum resistance, so dendrites cannot grow and crystals remain fine. Like air flowing through a tunnel, the path should be free of obstructions that can slow it down.

## Conclusion

The charger, applying the DEW algorithm, is designed to work in harmony with both the electrochemical process and composition of batteries. The proven technology, which can charge a NiCd cellular phone battery in as little as five minutes, provides the breakthrough in battery charging awaited by a mobile workforce. Two-way radio users, the first to benefit from this technology, are learning that batteries no longer have to be the Achilles' heel in job performance—and charging regimes are finally as simple a routine as putting on a uniform or taking a coffee break.



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# Cellular network emulation for specialized mobile radio

*Advances in switching and computer control allow smaller SMR operators to transcend technical barriers to providing subscriber cellular-like service, thereby expanding revenue and market opportunities.*

**By Jim Tucker**

The specialized mobile radio (SMR) industry has gone through a technical evolution, although one not as abrupt as developments in the cellular and personal communications services (PCS) industries. Although it has been a "given" that SMR serves different markets than PCS and cellular, technical advances in switching and computer control provide an op-

portunity for SMR to provide similar service. The following information explains a new method to do an old job and how to become a trendsetter in the SMR industry.

Since the first installation of cellular switching equipment and the inception of the cellular telephone industry in the early and mid-1980s, SMR operators have been asking for a cellular-like operational system for their industry. To date, only one large SMR carrier, Nextel Communica-

tions, McLean, VA, has been successful in implementing this type of operational capability on a large geographic basis. A smaller carrier, Hawaiian Wireless, Honolulu, operates a modified Ericsson cellular infrastructure and handsets that use SMR frequencies. The Nextel system uses the Motorola Iden digital format signaling and protocol. A new system design, the CellSMR, a cellular emulation switching system, is available to all SMR carriers. It offers:

- ❑ cellular-like networking, switching and call-handling.
- ❑ low-cost base station equipment as well as personal units.
- ❑ frequency reuse and frequency agility, permitting all SMR channels to be programmed into each base station RF unit and portable or mobile unit.

This system is a joint development of A Communications, Dallas, and Tecom, Taiwan, working together to provide a cellular type of operational efficiency in the SMR frequency bands. The system provides frequency agility and spreads the channel availability from the top to the bottom of the SMR allotted frequency spectrum. The joint engineering, including exclusive modifications to Tecom's switch design, has been accomplished and the equipment is now available for shipment and installation.

As shown in Figure 1 at the left, this new communications concept uses proven switching technology to emulate the cellular AMPS switching protocol. The AMPS format is embedded in the SMR transmit-receive unit and is used with a low-power-level transmitter combining package. Coupled to a feed-forward

Tucker is president of UltraTek, Corinth, MS, which provides consulting and marketing services for the switching system described in the article.

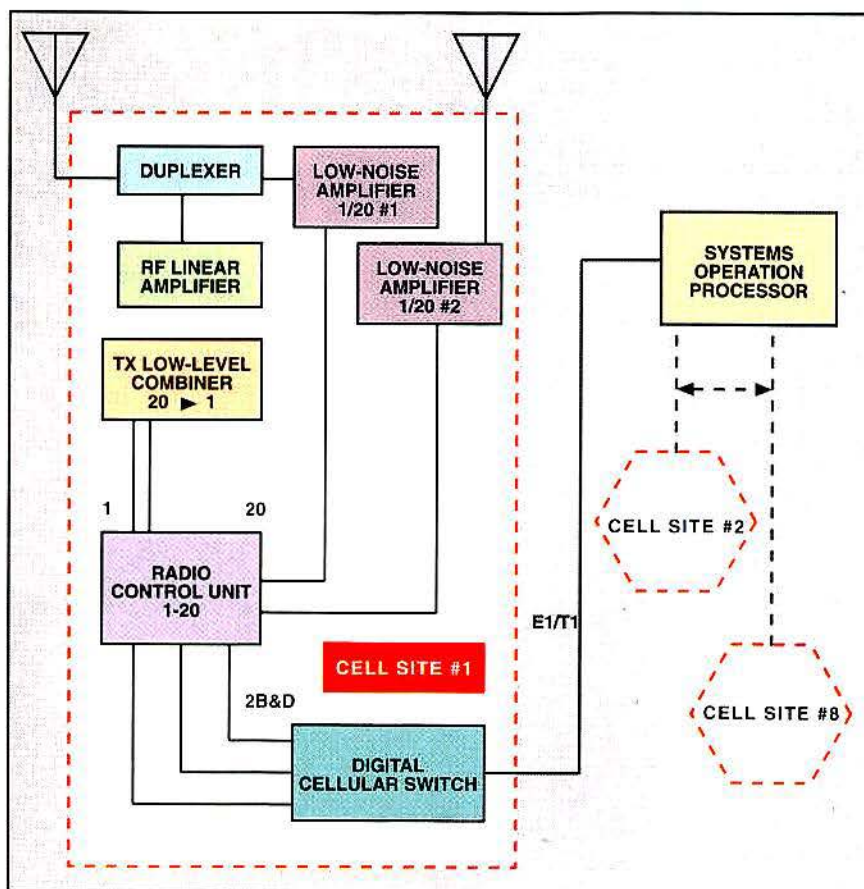


Figure 1. Block diagram of cellular SMR system, incorporating diversity reception.



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SS-18	15	18	2.3 x 6 x 9	3.6
SS-25	20	25	2 7/8 x 7 x 9 3/8	4.2
SS-30	25	30	3 3/4 x 7 x 9 5/8	5
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linear RF power amplifier and a computer-controlled digital switch, a frequency-agile, two-channel trunked SMR system, with full-duplex, cellular-quality interconnect and a standard dispatch SMR operation, is provided.

The earliest cellular emulation switching subscriber-based systems were launched in China, Taiwan and Guatemala and are now producing revenue. At several U.S.-based installations, beta testing

is being performed by Lubbock Communications, Lubbock, TX, Sioux Falls Two-Way Radio, Sioux Falls, SD, and Flagstaff Communications, Flagstaff, AZ, among others.

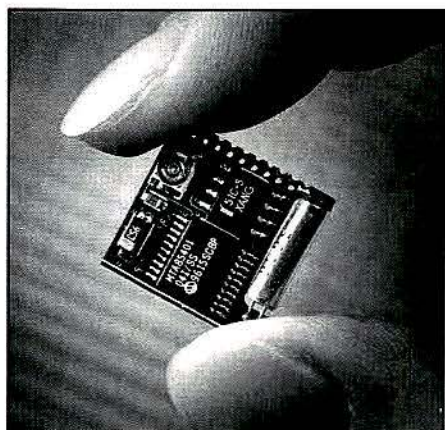
The site equipment has been FCC type-accepted, and 18 U.S. patent claims have been granted. A patent for the technology was issued in December 1997. Normal installation time on a five-channel system, once uncrated, is less

than four hours, including all connectors.

This system is designed for and aimed specifically at the small SMR operators who are continually losing customers to the new competition and technology that has developed during the past 15 years. Without the resources of the "deep pocket" competition and unless the small operators adopt innovative strategies, they face the same pattern of declining revenues and business consolidations that have affected some small two-way radio dealerships.

The new technology uses the cellular AMPS signaling protocol evolved by "downbanding" the RF units and compressing the 30kHz channel spacing to 25kHz, matching the SMR spectrum frequency requirement. All cellular software benefits are retained, such as subscriber equipment electronic serial number (ESN) assignment, which permits an almost unlimited subscriber database capability and establishes user codes for national roaming. Furthermore, the proprietary nature and controlled distribution of the system equipment precludes the cellular cloning fraud problem so prevalent in the cellular

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*As with cellular subscriber equipment, the unit automatically logs into the control channel when the subscriber roams into a new cell with total user transparency.*

AMPS signaling.

The system also provides for full-duplex or half-duplex operation, digital audio processing and diversity receivers with power level control that allows adjustable cell coverage and frequency reuse. As with cellular subscriber equipment, the subscriber unit automatically logs into the control channel when the subscriber roams into a new cell with total user transparency. When the subscriber moves out of the coverage area, the service light goes out, identical to regular cellular.

Low-power-level combining is a design feature combining repeater exciters operating at less than 1W output power level, then amplifying for full required system output power. A 12-channel combiner weighs less than 5 pounds and is less than 2 inches thick; however, it covers the




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entire SMR frequency band with no re-tuning required on the system.

The smart "feed-forward" linear RF power amplifiers automatically raise the power level to balance the base station output signal to the subscriber input level. This in-out balance is important, and SMR operators will be required to change the current prevailing attitude, "more power answers all needs." The in-out balance allows frequency reuse, and an in-

crease in subscribing mobiles, without interference from excessive RF "pollution."

The demand for portability in personal communications keeps increasing. Hand-held units will continue to replace vehicle-mounted mobile units and full-duplex operation is crucial to the future of SMR operators. Just as important is the ability to adjust to any SMR frequency in the system database similar to cellular, and the cellular emulation switching sub-

scriber equipment provides this ability.

The heart of the system is the computer-controlled digital switch. Intelligent switching between high and low channels, in conjunction with the system's switching software, provides the SMR operator with more flexibility and opportunity than has been available in the history of SMR. The system may be set up and remotely controlled via modems. Each cell site has a digital cell switch that handles all calls, whether dispatch or interconnect (PSTN), retains all call accounting for billing purposes, assigns the repeater frequency from the look-up frequency table and monitors call progress and status. The cell switch will also monitor the subscriber talk power level for hand-off when available. System-to-system networking with hand-off capabil-

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*Collision detection and avoidance allows low-use channels to be shared by the emulation system and traditional SMR systems.*

ity for exact cellular emulation will be available in the second phase equipment by the end of the first quarter of 1998. This feature is being designed for addition to existing equipment.

The system monitors channel activity and determines if a channel is busy or available for use. If a co-channel licensee keys up on a channel assigned to a remote control unit (RCU) or is detected as busy, the control computer immediately goes to a look-up table of frequencies and tells the RCU to go to another channel. This collision detection and avoidance allows low-use channels to be shared by the emulation system and traditional SMR systems. Spectrum usage efficiency is provided by a "dynamic frequency assignment feature."

Some of the advanced features available in the cellular emulation switching system include:

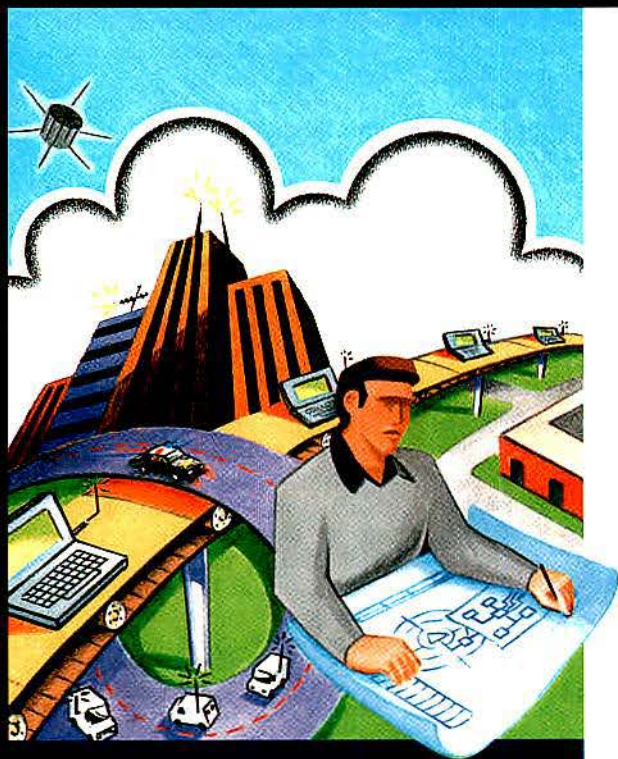
- ☐ frequency-agile RCUs that do not require contiguous spectrum because they are capable of operating on any available channel assigned by the control computer.
- ☐ automatic log-in to the control channel for automatic roaming capability.
- ☐ subscriber ESN with millions of identification number assignments.
- ☐ full-duplex interconnect calls, for



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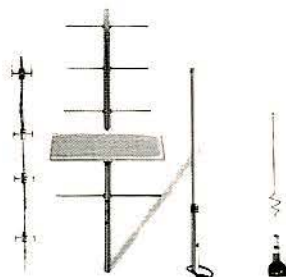
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## Lessons from cellular access technologies

By the MRT staff

System operators considering the potential for specialized mobile radio (SMR) to offer cellular-like service may wish to keep abreast of both technological and service issues in the cellular industry.

For service at cellular frequencies, four standards are now in use in the United States: the analog advanced mobile phone system (AMPS); and three digital standards, Global System for Mobile Communications (GSM) time-division multiple-access (TDMA) and code-division multiple-access (CDMA). The digital standards offer advantages in terms of spectrum efficiency and call privacy or security.

The weight of research and application in the cellular industry now seems to favor CDMA as the dominant digital technology. A report issued in the fourth quarter of 1997 by the Telecommunications Research and Action Center (TRAC), a Washington-based consumer research group, found that although analog systems offer the greatest availability, "all three of the digital technologies provide significant advantages over analog when it comes to services."

The report selected CDMA as nominally superior to the other digital services in categories such as signal security, enhanced services and recep-

tion, and "a clear winner" in comparisons of power needs and system reliability. The report also recommended that consumers may prefer to use dual-mode phones capable of switching between analog and digital services, particularly if inter-city travel or roaming is required, until digital systems are more widely established in the country.

According to a report by Dataquest, the number of cellular subscribers using CDMA systems will surpass those using TDMA by next year, with a concurrent decline in AMPS use, and a moderate growth in GSM use. Within three years, CDMA is projected to have a plurality of subscribers. The TRAC report also notes that CDMA offers advantages in land use and tower siting issues, requiring about one-third fewer cell sites than TDMA and a deployment ratio of about 1:3 with analog sites.

Ericsson, an established TDMA proponent, has also explored the CDMA technology by offering a wideband CDMA interface that uses a 5MHz radio channel instead of the 1.25MHz channel specified for IS-95-based CDMA systems.

These comparative differences and advantages are generally lost on consumers, however. A 1997 survey commissioned by Ameritech Cellular Services, Hoffman Estates, IL, demonstrated that 86% of consumers are unable to differentiate wireless phone service types. Only 8% of respondents were familiar with the terms TDMA, CDMA or GSM, and virtually none knew what the acronyms represented.

Similar confusion surrounds personal communications services (PCS), with only 3% of consumers knowing what PCS means.

"These different wireless technologies are not what's important to customers; what really matters to them is the quality of their service—that their calls go through when they want and need them to do so," said Herb Hribar, president of Ameritech Cellular Services.

Enhanced services is one of the driving factors in the cellular industry. Ameritech, for example, launched CDMA service in Chicago in July, promoting features such as caller ID, voice mail, and numeric and text messaging services.

Another enhanced service that will affect wireless adoption over the next few years is data transfer, particularly access to the Internet. Unwired Planet, Redwood Shores, CA, for example, is promoting access to the World Wide Web with a platform that connects mobile phones and other wireless devices. CDMA, TDMA and GSM are now deploying data communications protocols that are compatible with this type of access.

Clearly, issues that will affect the success of SMR as a cellular-type provider will include call security, siting, signal clarity and enhanced services, whether those services are integrated or bundled for the customer. If SMR operators choose to pursue the cellular customer market, the technology issue will not be nearly as important as the perceived needs of the users.



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Overall, the cellular AMPS signaling

protocol assures an ongoing compatibility with new cellular product developments. Additionally, 24 total inputs are included in the 20-channel configuration for future new technology, specifically dynamic carrier multiple access (DCMA) technology under development by ComSpace, Irving, TX (formerly Unique Technologies International).

### Conclusion

Implementation of the cellular emulation switching system can expand the business opportunities for SMR operators. Small SMR operators can upgrade to the system to effectively compete with large

wireless service providers. Spectrum-starved area SMRs can effectively form cooperatives and negotiate low-use channels, pooling frequencies for greater efficiency and resultant income. The system may also effectively benefit an SMR operator in purchasing SMR channels because contiguous channel spacing is not required. Local area incumbents can work together to compete with the new digital-based giant competition. Additionally, networking capability via use of microwave can efficiently extend coverage to any network geography required.

Additional online information about this system can be found at [www.cellsmr.com](http://www.cellsmr.com).





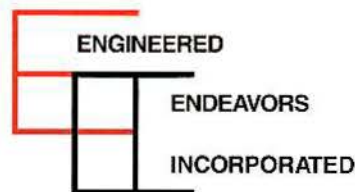


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# Service monitors

*The central tool in a technician's arsenal has to be selected for reliability and durability. Modularity and software upgrades are keys to functionality for a variety of procedures.*

## By the MRT staff

Service monitors are essential to wireless communications for two basic reasons: to maintain equipment in compliance with its licensed operating limits and

to troubleshoot problems when they occur. Radio system components that incorporate digital technology, integrated-circuit technology and surface-mount components have required increasing sophistication in service equipment.

The need for portable test sets that can

double as bench units and field units has resulted in a combination and miniaturization of devices that are necessary for maintenance and troubleshooting. Modularity and software upgrades are important keys to realizing this functionality.

The FCC has established tolerances for two-way communications, particularly related to transmitters. The operating frequency must be accurate and stable, power output and modulation levels must be regulated and spurious radiation must be suppressed.

The system operator has necessary business-related tolerances as well. Communications must be reliable, intelligible and free from interference for receivers as well as transmitters.

Basic requirements for test equipment to ensure compliance with technical regulations include a frequency counter or meter to assure that the transmitter is set on the assigned frequency. This aids tuning, checks frequency stability and avoids drift beyond the established percentage for the assigned frequency. A modulation meter determines that modulation is also within prescribed percentages and allows the system owner to improve coverage and reliability by letting the transmitter deviate to the maximum limit on the modulation peaks.

Power output meters are also useful in allowing transmitters to attain, but not exceed, their maximum limit; however, this is not as critical an issue with FCC-approved OEM equipment, which limits power by design. The power output meter is necessary in matching the transmitter to the antenna system.

A signal generator is generally needed for receiver alignment. Other necessary technical tools include volt-ohm meters (VOM), digital voltmeter and oscilloscopes. In recent years test equipment manufacturers have incorporated most of these elements into a single, portable unit suitable for both field and bench work: the service monitor.

Service monitors have become the central instruments for testing and analyzing



Technician using a test set for cellular analog and digital testing. In addition to hand units, cell sites can be standardized within a cellular system. Photo courtesy of Hewlett-Packard.



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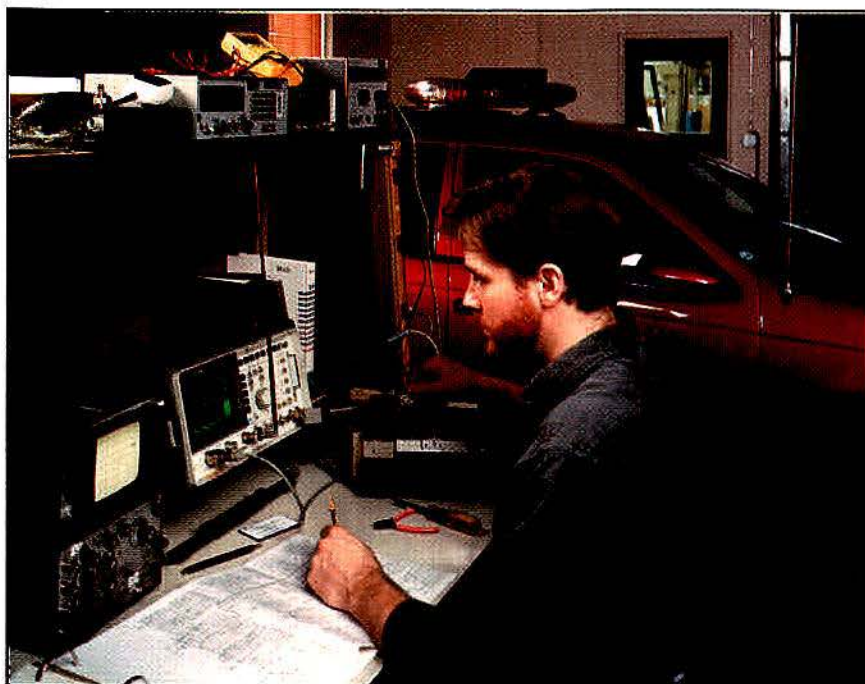
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Technician using a test set to check a public safety mobile. Software options allow retrieval of trunking parameters programmed into a mobile unit. Photo courtesy of Hewlett-Packard.

two-way equipment. They are not cheap, and technicians rightfully expect numer-

ous years of reliability and durability from the investment. The types and locations

of service for which the unit will be used should be considered when selecting an instrument, particularly if field work in inclement locations is involved. Constant use (or abuse) can lead to breakdowns that limit the work load and usefulness of the technician. Some monitors withstand continuous use; some need frequent repairs.

The primary functions of service monitors include radio-frequency (RF) measurement, RF power measurement, measurement of the deviations of speech and tone-coded squelch, frequency measurement of tone-coded squelch, and signal-to-noise and distortion (SINAD) measurement to check receiver sensitivity. Most monitors have a multimode code synthesizer that can generate all continuous-tone controlled squelch system (CTCSS) tones, paging tones, and digital code squelch signals. A signal generator, used in conjunction with an oscilloscope, is used in troubleshooting components. The spectrum analyzer, often offered as a system option, displays a window of the RF spectrum to allow checking for spurious outputs from transmitters and to analyze intermodulation interference.

There are well over 30 different manufacturers and suppliers of service monitor



## ANTENNAS & ANTENNA ANALYZERS

The complete line of AEA antennas and antenna analyzers are now available **FACTORY DIRECT** at the lowest possible cost. Each analyzer gives a **graphical display of SWR curves** with variable sweep width and center frequency. The 30-150, 150-525, and 806-960 MHz antenna analyzers are \$499.95 each plus \$7.50 shipping and handling. The SWR-121 HF analyzer covers 1-30 MHz and is priced at \$299.95 plus \$7.50 shipping and handling.

The AEA CableMate™ graphical Time Domain Reflectometer (TDR) is packaged the same as the SWR analyzers. The CableMate shows multiple faults in a cable on the graphical display. Virtually any multi-conductor cable may be tested for shorts, opens or impedance lumps. The CableMate is an excellent device for measuring the length of most any cable for inventory purposes. It will also directly show the 25 MHz return loss. An RJ-45 switch adapter allows easy testing of LAN cables. The CableMate is specially priced at \$359.95 plus \$7.50 shipping and handling for a limited time only.

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equipment. (For a complete list, see *MRT's Buyers' Guide*, December 1997.)

As a specific illustration of how equipment modularity and the ability to upgrade functions with software is offered by manufacturers, we have elected a workhorse monitor well-known to two-way technicians, the Hewlett-Packard 8920A RF communications test set.

First introduced in 1991, that service monitor was designed to perform more complete radio tests with less effort, to provide more reliable test results and to deliver a broader range of test capability in a smaller package. Its stored test routines allowed for replicable testing, before and after repair. Transmitter testing included measurement of frequency and power and simultaneous displays of deviation and audio frequency measurements. A radio's distortion, dc level current drain or SINAD could be measured and displayed. Both analog and digital readouts were made available for audio frequency, distortion, dc level and current drain. For receiver testing, measurements were provided for SINAD, distortion, audio frequency and ac voltage (audio power). Duplex radio testing included

displays of transmitter frequency or frequency error and RF power output.

The great contribution to technicians' workload of this and similar systems was automation. Automatic test routines were made available to speed up work, and provision was made for technicians to write their own routines with elementary software. In the case of the HP monitor, it runs on a built-in IBASIC computer.

The current version of the HP monitor combines 22 instruments into a portable package, applicable for land mobile, cellular and other communications systems operating in ranges as high as 1GHz. Using single-key procedures for transmitter, receiver or duplex tests, the monitor displays measured results on a single screen as either digital measurements or analog bar charts.

All settings can be saved in nonvolatile save-recall registers or on a SRAM card. Most service monitors now make a provision for hard-copy printout and an interface with a laptop or desktop computer, allowing technicians to have extensive record-keeping of service.

Available as an option, a signaling encoder and decoder can be added for all

common formats: tone sequential, digital paging, DTMF, trunking and cellular.

Software options extend the usefulness of the current generation of monitors. Options allow testing of trunked radio systems, checking links and even allowing retrieval of trunking parameters programmed into a mobile unit. Similar test sets perform these functions specifically for analog cellular, PCS and CDMA base stations and mobile stations, GSM900 and other systems. Software options increasingly reduce the time required to optimize the performance of a cell site and standardize test methodologies so that all sites are optimized to the same standards.

Experienced technicians have noted, however, that the available equipment is not a complete solution to troubleshooting and maintenance requirements. Even though test routines are available, the technician must know how to use the equipment and apply troubleshooting techniques. Procedures followed are dictated by the equipment available and by experience. A review of procedures after a job is completed can make the job go a lot faster.



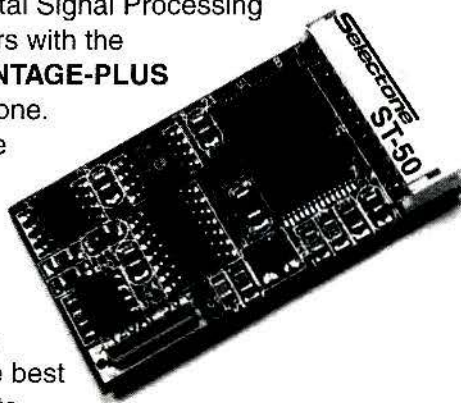
## THE ADVANTAGE-PLUS ENCRYPTION SERIES!!

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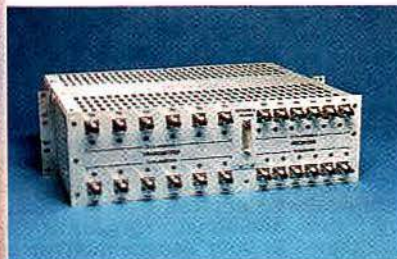
## Introducing the CATS 76000.

The only remote  
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you go through  
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There are many advantages worth reflecting on with the new CATS 76000. It provides you with complete cell-site antenna monitoring and pinpoints antenna feed line fault locations. The CATS 76000 also provides the automatic notification if VSWR exceeds user-defined alarm levels.

An even more convincing feature is its ability to measure single-channel transmit power while multiple channels are in use. Operators can identify problems they didn't know existed. No other system verifies and gives you the ability to adjust single-channel radio power in a real-time operational environment. None.

With the CATS 76000, you can diagnose



problems before sending someone out to the site. If a technician must visit a site, he'll go fully prepared to deal with the situation.

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## Remote Control for your Kenwood Radio



TK630  
TK730  
TK830  
TK930/931  
TK840  
TK940/941

The Alpha series MCR/TSR remotes and MCP/TSP series termination panels allows you to remote control your Kenwood conventional or trunking radio over any two wire voice grade circuit.

The Alpha series remote provides an LCD readout for channel number, up to 99, and a ten character channel name. Controls also include channel up and down, monitor, scan and privacy. All parallel remotes and the radio are updated simultaneously any time a change takes place.

Systems also available for Motorola, Midland and Johnson radios.

### Features

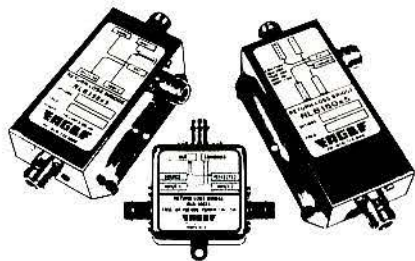
- Simple installation - No soldering, cutting or crimping.
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## EASY ANTENNA & TRANSMISSION LINE MEASUREMENTS



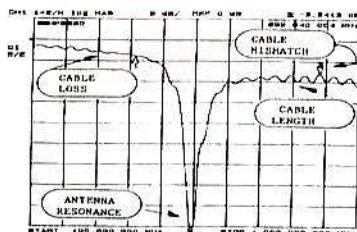
Return loss bridges from Eagle cover from .04 MHz to 3.0 GHz. These are self contained units that require no attenuators, amplifiers or detectors. All the additional equipment is contained in your service monitor or spectrum analyzer. Five watt power rating, unmatched in the industry, protects YOUR bridge from power coming from the antenna at crowded sites. Rugged nickel plated brass enclosures assure excellent durability.

Free: Application note, "Antenna and Feedline measurement", call and ask for it! The following EAGLE products will also aid in testing: Precision coaxial cable jumpers, power splitters, and reference terminations. Eagle RLB150 series bridges start at \$259.00.

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Tired of not knowing where your antenna stands? Wattmeters that test one frequency or antenna testers that are disturbed by outside signals letting you down? Most of the answer is on your bench. Adding an EAGLE return loss bridge to your service monitor makes a complete antenna measurement system.



## Technically speaking

(continued from page 8)

The square root of 0.02 is approximately equal to 0.14. Thus, the reflection coefficient at the transmitter is 0.14. At the antenna, the ratio of  $r/f$  is 4/50, or 0.08. The square root of 0.08 is approximately equal to 0.28. It is interesting to note that for a line loss of 3dB, the reflection coefficient at the antenna is exactly *twice* the reflection coefficient at the transmitter.

### Transmission loss

*Transmission loss* is a term used to describe just how much the signal power is reduced by a given mismatch, zero being the perfect figure for a *return loss* of  $\infty$ dB, or a *standing wave ratio* of 1:1 or a *reflection coefficient* of 0.0. The transmission loss can be determined from forward and reflected power by using the following formula:

$$T_L = 10 \log \left( 1 - \frac{r}{f} \right)$$

where  $T_L$  is transmission loss,  $r$  is reflected power and  $f$  is forward power.

Using our example, the forward power at the antenna was 50W, and the reflected power was 4W. Thus, the ratio  $r/f$  is 4/50, or 0.08, and  $1 - 0.08 = 0.92$ . The log of 0.92 is approximately equal to 0.036, and  $10 \times 0.036$  is 0.36dB. Therefore, the transmission loss caused by the mismatch at the antenna is 0.36dB.

### Additional line loss

An additional line loss is caused by the standing waves on the line. The net power absorbed or radiated by a load is equal to the forward power minus the reflected power. The loss of the line can be calculated from the net input power minus the net output power. In our example, the net input power was 98W, and the net output power was 46W. Calculating the loss from input to output results in a figure of about 3.28dB. This is 0.28dB more than the loss of the line under normal matched conditions. The additional 0.28dB of loss is caused by the standing waves.

### Summary

No matter what you might call it, the results are the same. A mismatched load will cause degradation in transmission efficiency. However, the actual transmission loss is not as severe as one might expect. Transmission line loss will mask the true SWR that exists at the antenna when measurements are made at the transmitter. By using the formulas presented here you can convert forward and reflected power into any of the other units of measure.

Until next time—stay tuned!



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## Do it for Reed

By Robert H. Schwaninger Jr.

Now that he's out of a job, I'm beginning to worry about Reed Hundt. So far, former chairman Hundt hasn't shown up on anyone's letterhead as the newest luminary. What does this mean? Is he having trouble landing after his turbulent flight as captain of the FCC fighter jet that swooped over the Capitol, dropping auction revenue on the Treasury? How will he pay his cable bill?

Because I think it would be unseemly to stand behind the unemployed Hundt in a grocery line, watching him count out food stamps, I propose that we have a little auction of our own. The proceeds would go toward making sure Reed isn't left high and dry. I propose that we auction off some Reed Hundt memorabilia. I admit that I stole the idea from one of those home shopping channels, but then an auction seems right to help Reed, so here goes.

By the way, each one of these items was collected from the basement, attic and dumpster serving the FCC. Each comes with a letter of authenticity signed by a guy named Murray, so you know that it's all good stuff.

### An HDTV receiver

Whadoihear for a high-definition TV receiver?! You could be the first person on your block to own one and beat the stampedes of shoppers who will be shelling out

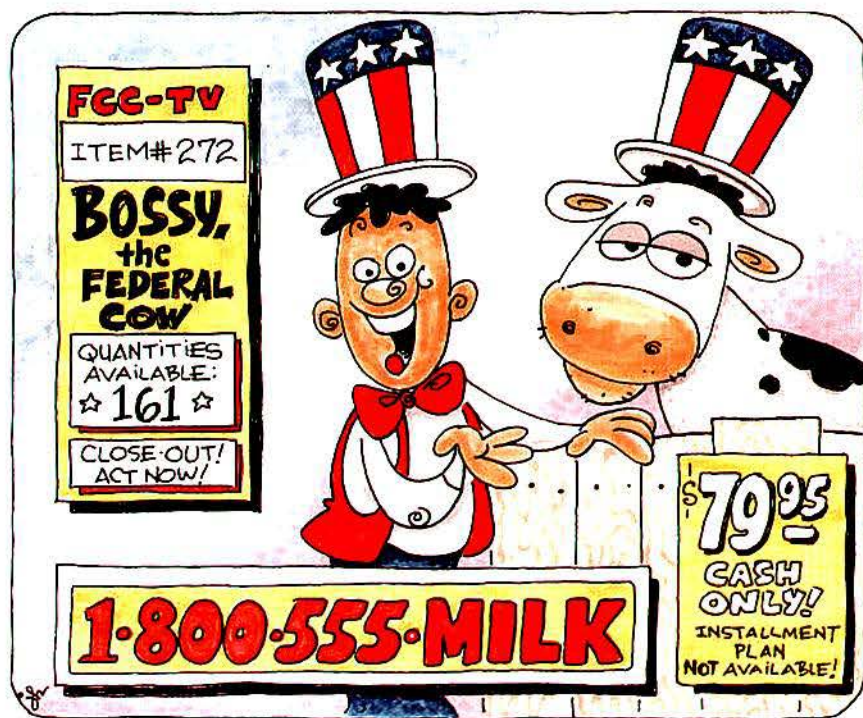


ILLUSTRATION BY JOHN HAYES

more than \$1,000 per set for these puppies, once they're on the market.

Okay, so there isn't a signal that they can get, and you can't even hook one up to the cable converter to download "The Best of Tony Orlando." But think about the stimulating conversations you can have with dinner guests as you explain the global industrial policy game that caused the Japanese-American trade negotiations to

explode when the Zenith standard was adopted for digital delivery. Hey, that's more fun than a game of Twister with Kathy Ireland!

### A CTIA bouquet

With many of the same lovely flowers found in the famous "tickler" from FTD, the CTIA bouquet is specially designed for that special someone at the FCC who covers your backside from regulation. Owing to the number of occasions one of these garlands was sent during the Hundt administration, we have a lot of these to offer to bidders. So, order three today, and we'll send you a dozen more absolutely free. They're great for parties, funerals or just to tell someone that you really are interested in hiring them later.

### A Block C letter of credit

This limited edition print is highly rare and available to only the first three callers. Used by PCS Block C auction winners, these letters were printed on cheap paper that, once exposed to sunlight, disintegrates rapidly. Embossed with disappearing ink, the bank's logo is the first to fade. But don't worry, the watermark remains as a permanent symbol of the company's stock. Makes a great gag gift

Schwaninger, MRT's regulatory consultant, is a partner in the law firm of Brown and Schwaninger, Washington, DC. He is a member of the Radio Club of America.

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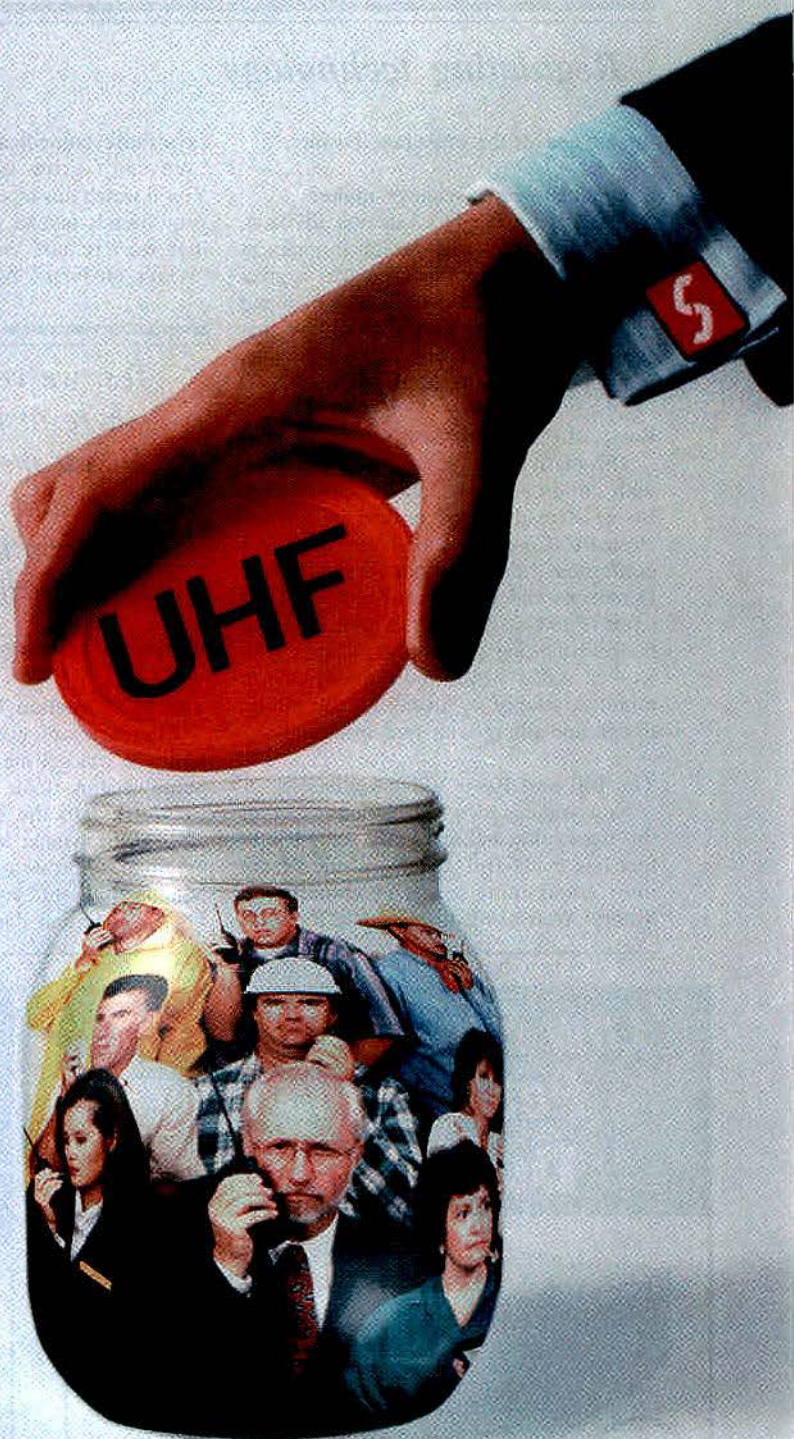


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The heart of the system, the SmarTrunk II Controller, offers such features as programmable call limit timers on a per user basis, radio kill for non-paying users, and the storage of complete call record accounting information. Custom trunking logic boards are available for a wide range of mobile and portable radios.



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### The Bill and Keep Video Collection

Now you can own the hilarious video of this wacky duo and roar at the witty banter that has made Bill and Keep one of the most entertaining teams in commission history! Watch as Bill's sidekick, R. Bock,

says those comedically immortal words, "We can't grow without the dough." You'll watch this tape again and again with your friends just to see if anyone notices that they're not viewing a remake of "Who's on First." Also available on CD.

---

*Yes, we've got it all  
here at the Reed  
Hundt memorabilia  
sale, and remember,  
your contribution go  
to a worthy cause...*

---

### The FCC Auction Home Game

After years of watching the real thing, now you can get the FCC's auction in the home version. Battle with friends and foes as you bid to the top of the heap and emerge the winner in your own spectrum auction. But watch out! The fun's only begun. Now sell your company's stock, float a bond and don't get caught by the

evil investment banker as you leverage for cash, prizes and the ability to financially survive while you pay for spectrum, equipment and distribution in this fast pace game. Fun for the whole family! Sorry, no C.O.D. or time payments available.

### The James Quello Punch-up Doll

Once used by Reed himself, this pop-up punching bag looks just like former commissioner James Quello. Take out your frustrations day after day by whacking Jimmy again and again and watch him bounce back for more. But that's not all! Each time Jimmy rocks back up, his hidden taped message clearly taunts, "That's one for the broadcasters." Relieves tension and stress, and makes a great Father's Day gift for the busy executive.

Yes, we've got it all here at the Reed Hundt memorabilia sale, and remember, your contributions go to a worthy cause—making sure Reed Hundt stays off the public dole. So, call today to place your order or just dial up the FCC Web site and click us your bid for these wonderful items. Orders of more than \$50,000 will be eligible for the Al Gore telephone cozy, the perfect cover for all federal phones.



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# Critical Control of 4 Base Stations

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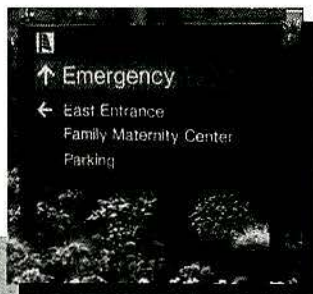
Zetron's Digital Tone Remotes are the preferred radio controllers for all critical applications.

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But most importantly, the remotes are from Zetron. This means **reliability** that is backed up by the industry's best warranty and technical support.

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*Digital Tone Remote*



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## FCC 800MHz auction closes; Nextel wins most licenses

The FCC 800MHz SMR auction came to a close on Dec. 8, 1997. Spending \$88.8 million, Nextel Communications, McLean, VA, won the most licenses—475 out of 525 available. Its purchase covers a hypothetical 732 million population (pops). Nextel is now present in all 50 states, and in all 175 economic areas (EAs).

The three-week-long auction, starting on Oct. 28, raised \$96 million in total net revenue. Licenses were divided into three-channel blocks in 175 markets. There were initially 62 eligible bidders, but only 10 bidders walked away with one or more licenses.

Coming in with the second highest bid was North Sight Communications, Puerto Rico, which bid \$1.57 million and won one license. Southern Company, Atlanta, won seven licenses with a bid of \$1,184,000, and High Tech Communications, Ocala, FL, won one license with a bid of \$1,182,750. Nevada Wireless, Winnemucca, NV, won 16 licenses, spending \$1.07 million.

Court appeals of the FCC Orders that created the auction are pending.

## Four new commissioners join FCC; Kennard is chairman

With U.S. Senate confirmation of President Clinton's FCC nominations, four new commissioners have joined the agency. Bill Kennard moves up from his post as FCC general counsel to become chairman. He replaces Commissioner James Quello and fills a term expiring June 30, 2001. Harold Furchgott-Roth, formerly the chief economist of the House Commerce Committee, takes a seat vacated in 1996 by Andrew Barrett and fills a term that expires on June 30, 2000.

Michael Powell, formerly chief of staff of the Department of Justice's Antitrust Division, replaces Commissioner Rachelle Chong and fills a term that expires June 30, 2002. Gloria Tristani, formerly with the New Mexico State Corporation Commission, was confirmed for two terms as

an FCC commissioner. First, she fills the remainder of Chairman Reed Hundt's term, which expires June 30, 1998. Her second term begins the next day and ends June 30, 2003. The fifth commission seat already is filled by Susan Ness, whose term continues through June 30, 1999.

Although commission terms are staggered to begin and end, one by one, over five years, many commissioners begin service after their terms already have begun and continue service after their terms expire. Federal law permits commissioners to remain in office after their terms expire and until a replacement is confirmed. Political and other considerations sometimes delay presidents from appointing replacements until months or years after terms expire.

## Hutton Communications relocates

Hutton Communications, has moved to a new corporate headquarters building in Carrollton, TX, a suburb of Dallas. The 72,000-square-foot building will also house the sales and warehouse operations of the company's Dallas branch. The new address is: Hutton Communications, 2520 Marsh Lane, Carrollton, TX 75006.

## BellSouth Mobility adds lightning protection at 18 cell sites

BellSouth Mobility has added Lightning Master Streamer Retarding brand structural lightning protection systems at 18 cell sites in the greater Orlando area. The structural lightning protection systems were designed and installed by Lightning Master, Clearwater, FL.

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In order for a company to survive in this communications jungle, it must produce a product that gives reliable service, is cost effective and operates at peak performance.

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Here is a list of just a few of the family's outstanding features:

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- Output to 500 watts VHF, 300 watts UHF & low band, 250 watts 800-900MHz.
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- Over-temperature & VSWR protection/power reduction.

### LMS Series -

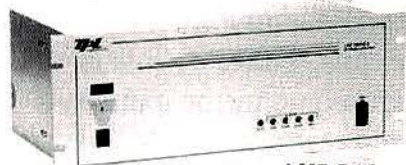
- Power levels up to 120 watts, from 35 to 960MHz.
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### RXR Series -

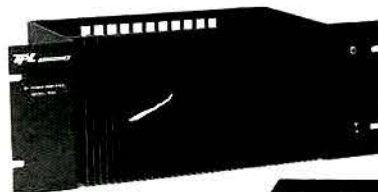
- Accommodates all bands from 35 to 960MHz.
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## MRT sponsors contest for IWCE '98

*Mobile Radio Technology* magazine is sponsoring a contest to be held at the closing session of the 22nd Annual International Wireless Communications Conference and Expo on April 24. The editorial and sales staffs are asking readers to bring in their oldest issues of the magazine. A grand prize will be awarded to the reader with the oldest issue, with a drawing to break a possible tie. Marketing Managers Joyce Bollegar and Dennis Hegg, and Classified Advertising Representative Dawn Rhoden will host the event, with Editorial Director Don Bishop presenting prizes on behalf of *MRT* advertisers.

*MRT's* first issue premiered in January and February 1983. Since then, *MRT* has been published monthly covering issues "all over the spectrum" of mobile radio communications.

## Motorola chooses Signal for pilot service program

Signal Communications Service, Fort Lauderdale, FL, was selected as the service provider in south Florida to participate in a Motorola pilot program, the Motorola System Service Subcontractor Assessment. The program puts the company through a series of rigorous evaluations, tracking, measurements and training that is designed to enhance customer service programs.

The Motorola assessment team evaluated Signal's ability to service the technical communications system used by city governments, police and fire departments, school systems, hospitals and major corporations. Beyond that, they analyzed Signal's policies, procedures and process flows for customer service.

## News notes. . .

**Bogen Communications International**, Ramsey, NJ, has completed its repurchase of the 64% interest in the company owned by **Geotek Communications**, Montvale, NJ. Geotek, meanwhile, is to equip the New Jersey Department of Transportation with automatic vehicle location software and a communications system to speed assistance for stranded or incapacitated motorists. The company also landed a \$2 million contract with Southeastern Pennsylvania Transportation Authority . . . **Metrocall**, Alexandria, VA, has purchased paging terminals and gateways from **TekNow**, Phoenix . . . FCC Administrative Law Judge John M. Frysiak has recommended that all licenses held by Marc D. Sobel dba **Air Wave Communications**, Los Angeles, be revoked. Sobel's attorney, Robert J. Keller, said: "We intend to submit a timely appeal. The judge does not acknowledge, much less address, the evidence we presented." . . . The **Cellular Telecommunications Industry Association**, Washington, has produced *Siting Wireless Antennas: An Introduction*, a guide for federal land managers.

**Intek Diversified**, Princeton, NJ, has converted repayment terms of debt worth \$23 million owed to its principal shareholder, **Securicor Communications**, to set back principal payments to July 2001. Securicor also agreed to invest \$15 million cash for a new class of preferred stock. In a separate action, Intek's board has allocated \$1 million to repurchase as much as 1% of the 42 million common shares outstanding . . . **CyComm International**, McLean, VA, is set to acquire **Omnidata International**, which makes hand-held computers and communications systems used on private radio networks by public safety agencies and commercial vehicle operators . . . **Ram Mobile Data**, Woodbridge, NJ, is teaming with **Microsoft**, Redmond, WA, to promote application development for Windows CE . . . **Arch Communications Group**, Westborough, MA, has agreed to sell its site management business to **Telecom Towers**, Arlington, VA, for \$40 million.

The city of Albuquerque, NM, in cooperation with Bernalillo County, has contracted **Ericsson**, Lynchburg, VA, to provide police and fire communications . . . **Pathnet**, Washington, will upgrade Northeast Missouri Electric Power Cooperative's internal communications network with digital technology . . . **Transcrypt International**, Lincoln, NE, has won a \$5.6 million contract from Rensselaer County, NY, that includes five 800MHz Multi-Net II simulcast trunked radio sites . . . **Enron**, Houston, will use **Motorola Flex** technology and **Mobile Telecommunication Technologies'** network to read electric meters remotely.

**Orbcomm Global**, Dulles, VA, has installed eight of 10 planned earth-orbiting satellites for its two-way data and messaging network intended for monitoring industrial assets, for tracking mobile assets and for exchanging two-way messages for recreational, commercial, military and automotive purposes.

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RF Design magazine has opened its Call for Papers for the RF Design '98 Conference & Expo. Technical papers are invited for the following areas:

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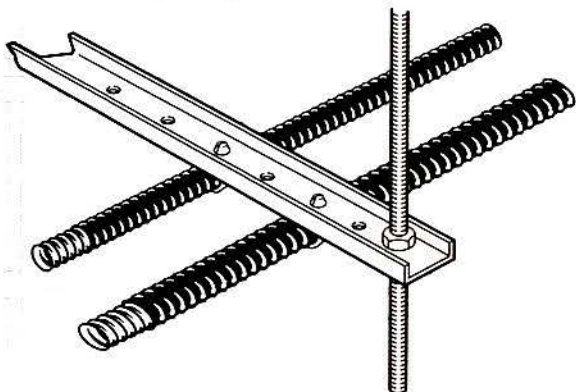
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## News

### Bearcom buys dealerships to expand business

Bearcom, Dallas, has been purchasing dealerships as part of its strategy to increase its market share in two-way radio sales and service and to add value to its current product and service offerings. Among companies acquired during the past year are HBE Communications, New Jersey; Racom Communications, Las Vegas; Cleary Communications, Boston; West Coast Radio, Los Angeles; Lipman Group Communications, Hartford, CT; Mobitel Communications, Houston; Tomba Communications, Houston; American Wireless Communications, Chantilly, VA; Cellular City, Las Vegas; Hands-on Communications, Brisbane, Australia; and Motorola Rentals, Schaumburg, IL.

Asked why Bearcom is acquiring businesses in an industry seen by some as less attractive than wireless telephone and messaging services, company president Jerry Denham said, "Two-way radio still provides an excellent solution for site-based applications to avoid recurring costs and increase operating efficiencies. Operating wireless within the confines of your own facility offers efficiencies, the ability to react in a timely manner, and a way to reduce the cost of employees required to handle a situation."

After searching the country for dealer acquisition prospects, Denham said he is amazed at the scope of dealership networks. "I've been finding companies with little public notoriety that have substantial revenue flows and good capabilities," he said. "There is no one source to find them."

Of paramount importance for Bearcom is finding ways to provide products with a lower cost basis to improve the company's customer service capability and to offer a broader range of products.

Denham said Bearcom is "number one in sales dealerships" for two-way radios. "We have sold more Motorola equipment than any other dealer, as well as having success with Maxon, Icom and Tekk." The company serves two-way radio users from the simplest to the most sophisticated applications. It provides bench-level equipment repair with a depot in Dallas, and offers field engineering, installation and service.

### Pagerola becomes GoComm Wireless

Pagerola, The Woodlands, TX, has changed its name to GoComm Wireless. Along with the name change, GoComm has moved into new, expanded facilities. Its new address is: GoComm Wireless, 1544 Sawdust Road, Suite 303, The Woodlands, TX 77380; phone: 281-298-2029; fax: 281-298-2863; email: [gocomm@gocomm.com](mailto:gocomm@gocomm.com); Web site: [www.gocomm.com](http://www.gocomm.com).

### Hialeah selects Motorola trunked radio system to improve interagency communication

Motorola's Land Mobile Products Sector, Schaumburg, IL, has sold the city of Hialeah, FL, a new, trunked, public safety two-way radio system for \$6.4 million. The 800MHz Smartzone analog system will replace the existing VHF and UHF communications systems currently used by the fire and rescue and police departments and by nine other local government departments and agencies.

The new system will be a three-site, 10-channel system using simulcast technology, a technology designed to provide improved coverage in high-traffic areas and inside buildings. With simulcast, voice messages are transmitted from more than one site at a time. This type of system is designed so that if the signal from one site is unclear or blocked, the signals from the other sites will automatically compensate. With simulcast technology, the transmission is not "handed off" as cellular telephone calls are.



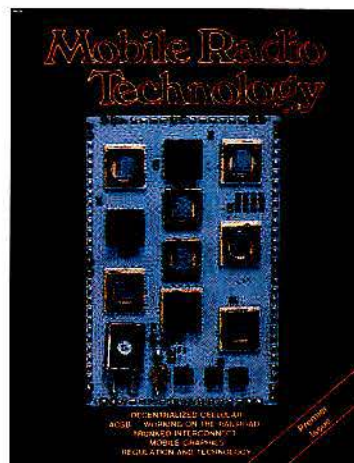
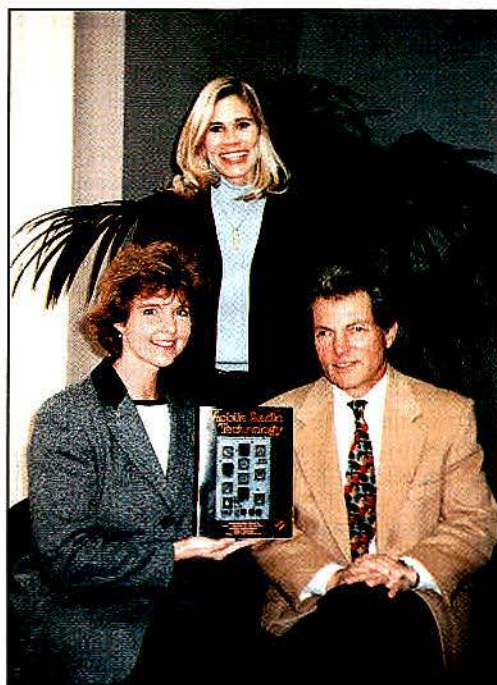
# Check your bookshelf

Our sales and editorial staffs are looking for the reader with the oldest copy of *Mobile Radio Technology*. Check under the desk, behind the door, on the top shelf or in the back of the file cabinet for your earliest copy, and bring it to our booth at IWCE '98 in Las Vegas.

Our enthusiastic Marketing Managers **Joyce Bollegar** and **Dennis Hegg** and Classified Advertising Representative

**Dawn Rhoden** will host an exciting and rewarding closing session at the **22nd International Wireless Communications Expo** held **April 22-24, 1998**, where Editorial Director **Don Bishop** will present the winner with the **GRAND PRIZE** on behalf of our advertisers.

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Marketing Managers Joyce Bollegar & Dennis Hegg and Classified Advertising Representative Dawn Rhoden are looking for the oldest existing subscriber copy. The first issue (above) premiered in January/February 1983.

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### SpaceCom Systems increases Ku-band capabilities at DFW Teleport

SpaceCom Systems, Tulsa, OK, has installed an additional geographically diverse uplink system at the Dallas Fort Worth Teleport.

The redundant satellite transmission equipment was to be activated on Jan. 1. The satellite network provider will put the additional satellite uplink system in place to serve as a secondary uplink site for the company's Ku-band FM Squared transmission service.

The primary purpose of the secondary uplink system in the Dallas area is to enable customers to achieve a quick recovery for their satellite networks, in the event of a catastrophic natural disaster at SpaceCom's primary uplink site in Chicago.

"It's a safeguard that we hope our customers will never need to use," said Bill Hartanovich, SpaceCom's vice president of

operations. "But if Mother Nature completely wipes out our primary uplink in Chicago, we'll still be able to transmit our customer's signals."

This secondary uplink system will sit constantly in "standby" mode, ready to take over transmission duties from SpaceCom's Chicago International Teleport (CIT). If a natural disaster or other calamity prohibits the CIT from transmitting to SpaceCom's satellite transponder, SpaceCom's backup uplink system in Dallas will automatically sense the lack of satellite signal and will begin implementing backup protocols and procedures to take over the uplinking duties.

"In effect, our primary uplink site could be struck down into a pile of rubble, but we would still be able to uplink our customers' networks," said Dale Bailey, SpaceCom's director of technical operations.

### Pyramid Industries acquires ETPS, creates new division

Pyramid Industries, Erie, PA, has acquired ETPS as successor company to Elgin Telecommunications Power Systems. The new division of Pyramid Industries, Pyramid Power Systems, is part of three existing manufacturing facilities. Pyramid

Power Systems develops switchmode power products, system controllers and self-contained small power systems. Products can be provided for large central office requirements, cellular and PCS sites, OEM and system support requirements.

### Consumers dominate paging

*PageTrac '97*, a study by The Strategis Group, revealed a radical shift in the customer composition of the paging industry. Over the last five years, the number of personal paging users grew from 4 million to more than 21 million.

While the number of intense business users grew from 9.2 million to 12.5 million between 1993 and 1997, the percentage of total users with little or no business usage of their pager expanded from 23% in 1993 to 46% in 1997. Almost 70% of new paging users are personal paging users.

The study also found that personal paging users are much younger than traditional business subscribers. Half of personal users are under the age of 29, compared to 18% of business users. While carriers and manufacturers are currently targeting the teenage market segment, this data indicates huge growth among twenty-something consumers.

Operators face new opportunities for brand differentiation of paging services. Personal paging users are much more likely to know the name of their provider than business customers, according to the report.



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### IWCE Workshops

In addition to IWCE Conference Sessions and the RF Design Seminar Series, a series of half-day and full-day IWCE Workshops will be offered to dealers and other industry professionals who are not necessarily RF design engineers. More details are available on Fax-On-Demand by calling 1-800-601-3858.



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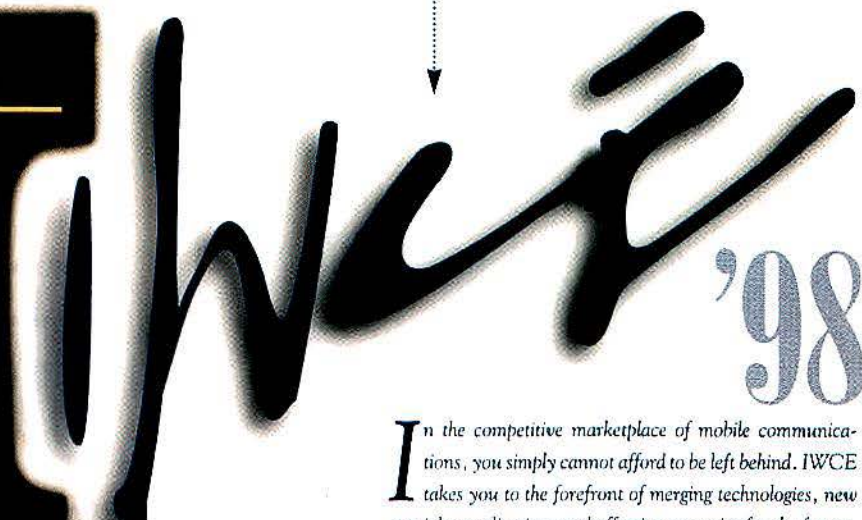
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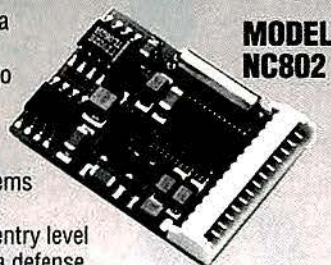
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## New products

### Readers' choice

Of all the new products and services in the June 1997 issue, the one reprinted here generated the most reader requests for additional information. If you missed it the first time, here is your opportunity to acquire more information on it. Just circle the corresponding Fast Fact Card number on the card found in the back of this issue and mail the card to us.

### NPCS modem allows wireless meter reading, control of appliances and equipment



A two-way paging technology that will enable utility companies to offer a variety of new services in the age of deregulation has been developed by the Messaging Derivatives Division of Motorola's Advanced Messaging Group. Using Reflex protocol-based, two-way paging, utility companies can now use a low-cost,

nationwide wireless network for automated meter reading and other utility automation applications. The device, the Reflex narrowband PCS modem, uses two-way paging to read meters during low-volume hours. It can also be used to facilitate demand-side management operations, such as controlling appliances in houses and equipment in businesses to prevent brownouts. The Reflex protocol is a part of Motorola's Flex family of paging protocols.

Circle (500) on Fast Fact Card

### Power system features switchmode rectifier design

The Galaxy power system 4848 from Lucent Technologies' Microelectronics Group is a 48V, 4,800A power system for communications service providers that reduces system size and provides an architecture that can be installed, maintained and upgraded without disrupting service. The front-accessible power system is for use in wireless switching centers, as well as central and remote wireline switching offices. The system features an advanced 200A switchmode rectifier design and a modular architecture with hot-swappable components and versatile control and monitoring facilities. The GSP 4848 uses as many as 24 fan-cooled, 200A switchmode rectifier modules located in multiple cabinets that can supply from 200A to 4,800A at 248Vdc.

Circle (301) on Fast Fact Card



### Sports information service provides game updates

ESPN To Go paging service from **Motorola's InfoPower** paging information service subsidiary provides instantaneous, up-to-the-minute sports information including game schedules with point spreads, scores, pre-game analysis, post-game wrap-up, injury reports, stats, major late-breaking headlines, and who's hot and who's not in a variety of sporting events. The information is available any time, anywhere via pager from paging company networks in the United States and Canada. The service provides updated sports action every five minutes while games are in progress. In addition to NASCAR updates for Winston Cup races, PGA leader board updates and regional horse racing information, the service provides general sports news plus score and game information updates for NFL football, NBA basketball, Major League baseball, NHL hockey and Division I NCAA football and basketball.

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### Terminals provide interference-immune signals

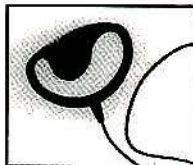
**World Communications Group's** Wincom is a series of direct-sequence, spread-spectrum terminals suited for applications requiring a reliable transparent link between computers, peripherals and communication devices. Interfacing via RS-232, V.35 or RS-422 connection, they easily communicate with sensors, monitors, receivers and other data-acquisition products. The product line features asynchronous and synchronous models, with data rates to 256kbps, offering a range of as much as 30km line-of-sight. Operating in the 900MHz and 2.46Hz ISM frequencies, Wincom does not require an FCC site license. Using spread-spectrum technology, they provide interference-immune signal transmission through walls, floors, glass and other obstructions. Wincom operates full-duplex, Hayes-AT compatible, and supports commercially available communication software such as Procomm, PC-anywhere and X-talk. Channel selection and power control are automatic and transparent to the user. Wincom can be configured for point-to-point, point-to-multipoint, wireless LAN bridge and multiplexer telephone link.

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### Receiver provides alternative to in-ear devices

The ParMarLow ES-MUR on-ear receiver from **TwitCo Distributing** is for Motorola radios requiring a locking 3.5mm connector. The ES-MUR000-02 is compatible with the following Motorola radios: Visar, HT1000, JT1000, MT2000, MTS2000, MTX8000 and MTX9000. The receiver provides a comfortable, noninvasive alternative to in-ear devices. The receiver is recommended for patrolmen, swat teams, bike patrols and extra-duty personnel.

Circle (304) on Fast Fact Card



### Adapter kit provides 7/16 DIN for various apps



**ITT Pomona Electronics'** model 6254 7/16 DIN adapter kit provides the cellular communications technician with a variety of adapters that simplify installation and repair operations.

Suitable for use in cellular telephone communication installation and service, the 7/16 DIN adapters reduce intermodulation generation and improve the ability to accommodate multiple frequencies. Other features of the 7/16 DIN adapter include improved VSWR performance, more stable electrical and mechanical connections than can be obtained with type N connectors, peak power rating of 40kW as compared to 10kW for type N connectors, greater resistance to environmental conditions and longer service life. The 7/16 DIN adapter coupling mechanism provides higher contact pressure and full circumference contact. The adapter kit includes six adapters: 7/16 DIN male to 7/16 DIN female right angle adapter; 7/16 DIN female to 7/16 female to 7/16 female barrel splice; 7/16 DIN male to N male; 7/16 DIN male to N female; 7/16 DIN female to N male; and 7/16 DIN female to N female.

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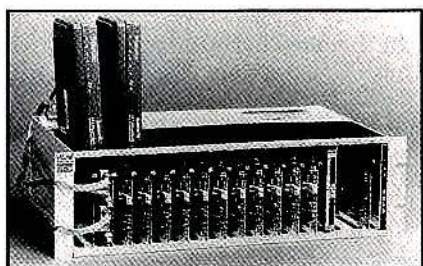


Circle (62) on Fast Fact Card



## New products

### Paging option allows external modem choice

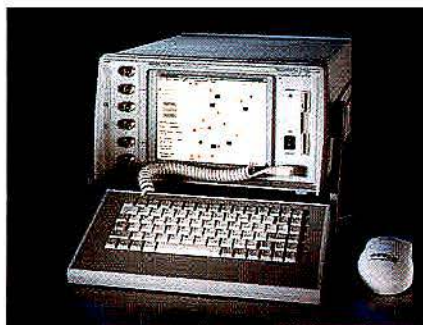


An option for the TAP 2000 alpha concentrator from **Hark Systems** allows paging operators to use external modems. So with the rapid growth in modem technology, operators' systems are not made obsolete, and for the system operator, this allows the ability to conform to issues of

modem compatibility as more data messages come from a wider variety of sources. As with the TAP 2000, this option allows 24 inputs using one high-speed port into the paging terminal. While the TAP 2000 allows connect speeds up to 14400 baud, operators selecting the external modem option can connect modems at data speeds about 14000. This option operates in conjunction with standard TAP 2000 modems. The option supports on-board TDD capability, allowing TDD access without adding a separate modem and a separate line. The modem on-trunk feature is supported without additional lines or purchasing a separate modem.

Circle (306) on Fast Fact Card

### Platform tests third-generation mobile phone systems



Noise Com's MP2700 is a platform for its line of multipath fading emulators. The MP2700 tests third-generation mobile and

base station equipment for IMT-2000 (FPLMTS) and W-CDMA, as well as digital-TV applications. The MP2700 system simulates one or two wireless communication channels with propagation over as many as 24 simulated signal paths for more rigorous frequency-selective fading and delay tests. The channel propagation model is updated with 12-bit real-time processing using 65MHz DSP technology for precise and realistic emulation of multipath fading. The platform meets the wideband and spread-spectrum application requirements of IMT-2000 and W-CDMA with a RF bandwidth of 24MHz.

Circle (307) on Fast Fact Card

### Pager tester features functions for testing, aligning, repairing

The Tescom TC-1101A Pager Tester from **CPR Technology** integrates all required test functions required to test, align, re-crystal and repair pagers. Features include a signal generator, Flex and POCSAG encoder, IF generator, fre-

quency counter and ac milli-voltmeter. The unit is small and full-featured, measuring  $5\frac{7}{8}'' \times 8\frac{5}{8}'' \times 13''$ . A built-in RS-232C computer interface allows for automated testing and pager label applications.

Circle (308) on Fast Fact Card

### Filter takes lightning to ground



The Quarter Wave series for RF and coaxial protection from **Northern Technologies** acts as a bandpass filter diverting lightning to ground and allowing only the tuned bandwidth to pass through the device, thus keeping harmful energy away from critical equipment. The QWS series can protect frequency ranges from 810MHz to 1,970MHz with a variety of connector arrangements.

Circle (309) on Fast Fact Card

### Charger features three-phase charging for rapid recovery



Newmar's Phase Three charger features three-phase "smart" charging for rapid recovery, as well as a selector switch to set proper float and charge voltages for either gel cell or wet lead-acid

batteries. Temperature compensation fine-tunes output voltage for optimum charging even in extreme high- or low-temperature battery environments. An automatic high-voltage time-out circuit protects batteries against overcharge under high continuous load. The case is constructed of rugged stainless steel, with ammeter and integral cooling fan.

Circle (310) on Fast Fact Card

### Antennas feature high gain

Maxrad's "Gain with value" mobile antennas deliver 3dB or 5dB gain. The MMC molded coil series mobile antennas feature high gain, 3dB gain in VHF and 5dB gain in UHF. Available models cover any frequency that lies within 118MHz-512MHz. Either black or chrome finish rods can be specified, and a shock spring is available on all models. The antennas fit Maxrad's selection of  $\frac{3}{4}''$  mounts.

Circle (311) on Fast Fact Card



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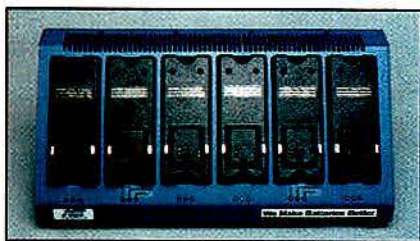



Circle (63) on Fast Fact Card



## Charger uses technology to condition batteries

**A**dvanced Charger Technology's six-bay Activator VI for two-way radios batteries incorporates dynamic electrochemical waveform (DEW)



technology. In addition to charging quickly, the activator conditions as it charges, provides a maximum charge every time and triples the life of a battery. Batteries can be left in the charger indefinitely without losing charge or incurring damage. DEW technology works with a microchip to "look inside" each battery and adjust charging and conditioning to its specific needs. DEW works with the chemistry of the battery. The activator takes about 30 minutes for a typical 1,200mAh battery without heating.

Circle (312) on Fast Fact Card

## Trunking portable allows operation for business pool

The SPU554KTS from Uniden Private Radio Communications is a trunking portable that allows operation across the full UHF industrial and business pool defined in the FCC refarming rules, plus the 470MHz-494MHz T-band frequencies. The portable operates on a full 44MHz bandwidth. It offers 100 talk-group capacity, an alphanumeric backlit LCD display and the DTMF keypad and 1,200mAh battery as standard. It carries the same case design as other Uniden VHF and UHF conventional models and is programmable for 12.5kHz and 15kHz narrow or 25kHz and 30kHz wideband operation by system. The portable has five functions programmable for instant access by either of two "quick keys" or accessible from a menu.

Circle (313) on Fast Fact Card

## Time & frequency system supports several apps



Measuring 7.3" x 1.5" x 9.9", the GPS Time-machine/TM-3 time and frequency system from Spectrum Geophysical Instruments is a time and frequency reference with the features and performance to sup-

port a wide variety of applications. These applications include telecommunications, network synchronization, data acquisition, power utility monitoring, calibration reference and other scientific and commercial applications. The system integrates a five-channel Global Positioning System (GPS) satellite receiver, microprocessor-controlled timing and interface logic and an oven-controlled crystal oscillator. The system uses information transmitted by the GPS satellites to derive time information for use in applications that require a precise time or frequency reference.

Circle (314) on Fast Fact Card

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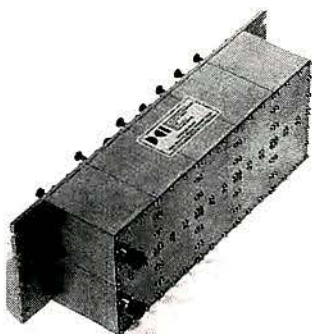


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Circle (67) on Fast Fact Card

## New products

### Repeater works for CDMA, TDMA, GSM 1,900MHz systems

The Allgon TDMA adjustable band selective and C D M A channel selective repeaters have received FCC approval. The repeater has a unique design, allowing one person to install it, and it has a sleek weatherproof exterior case that acts as the cooling system. It can easily be upgraded for use of fiber, by a flexible module system. It uses Windows-based supervision and monitoring software designed to communicate with the existing NOCC and OMC. All operating characteristics can be controlled locally or remote in real time.

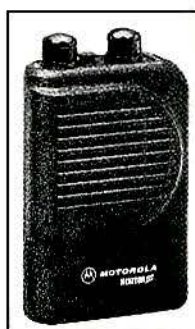
Circle (315) on Fast Fact Card



### Alert monitor receiver performs in severe conditions

The Minitor III alert monitor receiver from Motorola's Customer-Owned Messaging Group has more capabilities including scanning, vibrating alert and expanded calls. With features such as corrosion-resistant packaging and more than 35 hours of battery life, Minitor III alert monitor receiver performs under severe conditions. The receiver's compact design also includes field programming capabilities for frequency and codes and is able to handle six calls per channel. The Minitor III receiver's channel scan capabilities allow customers to listen to channel traffic on two separate channels, so important calls are received. The Vibra-page feature alerts customers to incoming pages, keeping them informed in loud and tough conditions.

Circle (318) on Fast Fact Card



### Antenna covers PCS spectrum

The Hi-gain omni collinear dipole, model AOC-202 from Astron Antenna is an omnidirectional antenna covering the entire PCS spectrum (1,850MHz-1,990MHz). The large elevation beamwidth, 6.5dBi gain, and VSWR of 1.5:1 makes it an efficient broadband omnidirectional antenna. The rugged construction of the AOC-202 allows it to withstand as high as 110mph winds, while the UV-protected ABS plastic radome protects it from the harsh elements. Other features include 500W power, impedance of 50Ω and vertical polarization. The mechanical dimensions are 2.25" x 16.5" with a 1.5" mounting clamp area. Type N flange mount connector is available also.

Circle (316) on Fast Fact Card

### Rechargeable battery works in land mobile, cellular industries

The JB-8100 from JBRO Batteries is a high-capacity NiMH rechargeable replacement battery for the Nextel Powerfone. It is designed for use in the land mobile and cellular industry. The JB-8100 is rated at 6V, 1,800mAh with a size of 4.85" x 2.325" x 0.825". It replaces the Motorola NTN 8100.

Circle (317) on Fast Fact Card

### Software provides essential tests for base stations



The Basepak distance-to-fault software package is an adjunct to Advantest U3641 portable spectrum analyzer. The Basepak package was developed by Rohde & Schwarz, Germany, and is marketed and supported in the United States and Canada by Tektronix under a strategic alliance formed in 1993. A Basepak-equipped U3641 is an integrated "one-box" that provides all four of the essential tests for base station installation and maintenance—antenna measurements, transmitter measurements, spectrum monitoring and filter and duplexer checks. Basepak delivers antenna return loss and distance-to-fault readings to an external PC coupled via GPIB to a U3641 equipped with the optional tracking generator.

Circle (319) on Fast Fact Card



## Radio case offers swivel attachment



Raine's two-way radio case features a metal-to-metal swivel attachment. The case is made of heavy grade nylon webbing with an adjustable re-

tainer strap. The detachable swivel belt loop allows the radio to be used while it remains in the case.

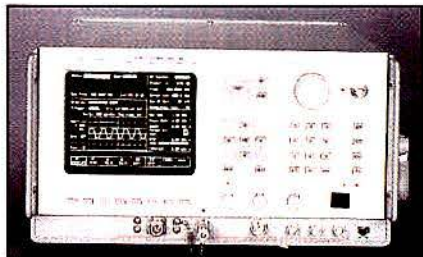
Circle (320) on Fast Fact Card

## T-frame sector mount provides directional, downtilt control

Universal T-frame sector mounts by PiRod provide precise directional control of cellular and PCS antennas without additional downtilt brackets. Versatile mounts attach to any communication tower with standard 4 1/2" O.D. pipemounts. Two adjustable tiebacks assure a rigid and stable mounting system. Antenna spacing can be adjusted on the 15-foot-wide T-frame mounts, and additional mounting points can be added at any time. Installation and service access are made easy by the T-frame design, which incorporates a standing rung for service personnel.

Circle (321) on Fast Fact Card

## System analyzer supports Project 25



The R-2670 FDMA digital communication system analyzer from Motorola Communication Test Equipment supports testing needs for APCO Project 25 through new model options. The option tests Project 25-compliant conventional systems, the IMBE vocoder and multiple-encryption algorithms, including DES-OFB. The R-2670 also can include test capability for Astro VSELP and SecureNet radios and base sites. The analyzer in Project-25 mode can generate RF transmissions modulated with either a 1.011Hz tone test pattern or a calibration test pattern that generates a 5% bit error rate (BER) for unit under test BER measurement with Project 25 test mode.

Circle (322) on Fast Fact Card

## NiCD, NiMH battery can remain in charging system indefinitely

Pulse Power's battery charging system uses advanced microprocessor technology, employing a patented magnetic latch system to secure the battery. The user places the battery in Pulse Power until it receives 1,000 to 3,000 charges per use cycles. Pulse Power simultaneously eliminates "memory effect" while charging NiCd and NiMH batteries to 100% capacity in about one hour. Once a battery is fully charged, Pulse Power transfers into maintenance mode, and the battery can remain in the charger indefinitely. Pulse Power is available for Motorola cellular phones and 160 other models including AT&T, Audiovox, DiamondTel, Ericsson, JVC, Mitsubishi, NEC, Nokia, OKI, Panasonic, Pioneer, Tandy, Technophone and Toshiba. Pulse Power is also available in three camcorder models.

Circle (323) on Fast Fact Card

## Billing software processes thousands of calls per second

The Genesis Group's airtime accumulation software GenSZAI (Genesis SmartZone Airtime Interface) uses multithread software technology to allow high-speed processing and accumulation of thousands of calls per second, as well as telephone call detail for reconciliation or billing of telephone usage. The program is divided into four distinct modules (Accumulator, Set-up, Query and NetVista). The Accumulator module accumulates dispatch, telephone and private conversation airtime usage. Set-up allows the operator to set prime, off-prime and accumulation methods (seconds or channel seconds). In Query, the following reports are created: airtime usage "Roll Over," telephone call detail, reports on all IDs using the SmartZone system and basic system usage information.

Circle (324) on Fast Fact Card

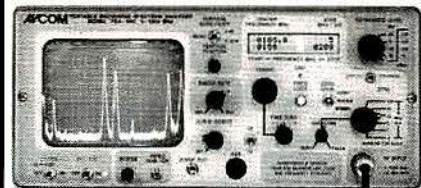
## Mobile data computer offers several functions

Mentor Engineering's Mobile Data Computer's (MDC) integrated design combines the functions of multiple devices, offering two-way messaging, internal GPS, eight-line transreflective graphics-card display, PCMCIA slot, multiple I/O and internal smart card/credit card reader in one compact unit. It is compatible with a wide variety of communication networks and integrates to dispatch software through Mentor's Xgate software module.

Circle (325) on Fast Fact Card

## NEW MULTIFUNCTION LCD AVCOM's PSA-65C

### Portable Spectrum Analyzer 1-1250 MHz In One Sweep!!



AVCOM's newest Portable Microwave Spectrum Analyzer, model PSA-65C, has a frequency range from less than 1 MHz to 1250 MHz with a sensitivity greater than -95 dBm at narrow spans, for the amazing price of \$3175.

AVCOM's new PSA-65C is a low cost general purpose spectrum analyzer that's loaded with standard features including FM audio demodulator, AM detector and digital frequency lock. The PSA-65C covers frequencies thru 1250 MHz in one sweep. The PSA-65C is ideally suited for 2-way radio, cellular, cable, satellite, LAN, surveillance, educational, production and R&D work. Options include new 1250 MHz frequency extenders, BNG-1000A tracking (noise) generator, log periodic antennas, carrying case (AVSAC), and more.

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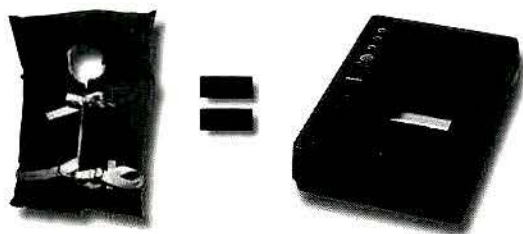


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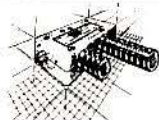


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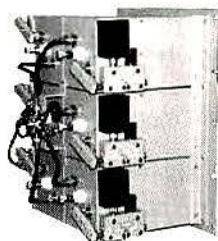
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## P eople



Carello



Scheifele



Friedrichs



Tant

**Thomas Carello** leaves Roamer One, Torrance, CA, as regional manager, to join Lenbrook Wireless Communications, Pickering, Ontario, Canada, as sales director for Powerwave products.

**John F. Scheifele** departs Telecommunications Research Associates, Dublin, CA, as division vice president to become vice president of marketing at Call Sciences, Edison, NJ.

Changes at Signal One, Chattanooga, TN:

**Bill Friedrichs** departs Glenayre Electronics, Charlotte, NC, as director of contract services to join Signal One as chief operating officer.

**Pat Tant**, vice president of operations, advances to vice president of sales and marketing.

**Joe Glassett**, sales administration manager for Kenwood Communications, Long Beach, CA, moves up to operations manager.

**Mario Cid Fernandez** leaves Hughes Technical Services, Fort Irwin, CA, as North American sales manager for the Magnaphone, to join O'Gara Satellite Systems, Deer Park, NY, as director of sales for the mobile satellite communications products.

Changes at TruePosition, Vienna, VA:

**Michael McGoldrick** leaves Ericsson, Lynchburg, VA, as director of sales and marketing to join TruePosition as vice president of sales.

**Paxton J. Louis** leaves NextWave Telecom, Hawthorne, NY, as director of technology to join TruePosition as vice president for carrier marketing and technical support.

Changes at Superconducting Core Technologies (SCT), Golden, CO:

**Robert F. Paige** leaves GE Capital and Telecom Group, Norcross, GA, as vice president in business development to become chief executive officer at SCT.

**John Schaller** departs AirNet Communications, Melbourne, FL, as chief financial officer to join SCT as chief financial officer.

**George Shaginaw** becomes Cellular Telecommunications Industry Association's (CTIA) vice president for technology and operations, a new position in the association. Shaginaw's industry experience includes being executive vice president of Pacific Telecom Cellular, Appleton, WI.

Changes at Northern Telecom (Nortel):

**Jim Long**, executive vice president and group executive-Asia advances to executive vice president, Enterprise Networks. He succeeds **Rick Faletti**, who is leaving the company to pursue other interests. **Clarence Chandran** assumes responsibility for Asia, in addition to his role as executive vice president, Public Carrier Networks. **David Ball**, senior vice president, Public Carrier Networks, Europe, is retiring this year.





## Booklet offers shortcuts for use of power products

**Hewlett-Packard's** booklet, "10 Practical Tips You Need to Know about Your Power Products," provides power product engineers with helpful hints for enhancing power product operation and using measurement capabilities. The booklet is free and includes shortcuts and recommendations in areas such as using remote sensing to compensate for load-lead effects, charging and discharging batteries, using remote inhibit and the discreet fault indicator, eliminating noise from low-level measurements, understanding down-programming, using constant-current load with foldback power supplies, getting higher voltages and currents by connecting power supplies in series or in parallel, making pulsed- and dynamic-current measurements with a power supply, characterizing ac inrush current, and measuring supply current to the DUT (device under test).

Circle (351) on Fast Fact Card

## Brochure describes RF shielding

**Lindgren RF Enclosures'** brochure on its cell-type shielding system for RF shielding describes the system's modular, clamp-together construction. The system delivers high-performance attenuation over a frequency range of 10kHz to 40GHz. It exceeds most government specifications for basic applications including Mil-Std 285, NSA 65-6/94-106 and CID 09.12, as well as other commercial needs. The system is constructed of prefabricated double steel laminated, featuring solid sheets of G90 28-gauge galvanized steel laminated to both sides of 3/4" thick dimensionally stable high-density core. These shielded panels are then clamped together to form self-supporting walls, floors and ceilings for enclosures of all sizes. Lindgren's flat contact clamping system provides improvements when compared with typical clamp-together enclosures.

Circle (352) on Fast Fact Card

## Study examines paging trends from last year

**PageTRAC: Consumer Trends in Paging: 1997** from **The Strategis Group** offers an in-depth examination into paging's rapidly changing user profiles, usage patterns and interest in new services. This study is a culmination of both primary consumer survey data and additional primary research into carrier and manufac-

turer retail paging trends. The study includes: paging user profiles and demographics, usage trends, awareness and churn trends, distribution trends for the users and carriers, retail pricing for paging service and equipment, equipment trends and the impact of cellular and PCS competition.

Circle (353) on Fast Fact Card

## Guide describes accessories

**Hutton Communications' 1997/98 Wireless Telephone Accessory Guide** features accessories for cellular, ESMR and PCS telephones. Products from more than 40 manufacturers are featured in the guide. The guide also includes installation products and mobile office and pager accessories.

Circle (354) on Fast Fact Card

## Guide features telecom acronyms

**Keithley Instruments' Telecommunications Acronym Directory** is a handy reference guide to often-used acronyms and abbreviations in the telecommunications industry. The directory is co-published with *Microwaves & RF Communications Products* for engineers in the telecom industry.

Circle (355) on Fast Fact Card

## Book details how to predict land mobile radio system coverage

**Artech House's Handbook of Land-Mobile Radio System Coverage** by Garry C. Hess is a unique book and software package. Describing system aspects such as propagation, modulation, coding and frequency reuse, it also addresses how to use this information to predict, verify and measure radio system coverage. This book is for readers who are responsible for specifying the site layouts of conventional or cellular land-mobile radio systems. It shows how to handle both Rayleigh fading and lognormal shadowing in coverage prediction and how to estimate signal strengths and bit-error probability. It also

details how to implement acceptance procedures that help to determine if a particular test plan will be cost-efficient. Supplemented with more than 50 examples of real-world radio system coverage problems, the book also suggests how system coverage procedures will evolve in the coming years. Other chapters detail expressions for area coverage, models for median path loss, relations for the ratio of desired to undesired signal level, and how to tabulate gains and losses to establish communications distance. Designed for use with the appendices of the book, an accompanying 3.5" diskette contains FORTRAN source code.

Circle (356) on Fast Fact Card



## Mobile Radio Technology

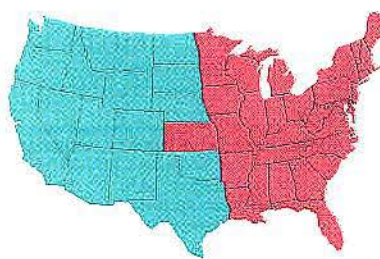
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## Professional services

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### Employment

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**Two Way Radio Service, Inc.**  
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Casper, WY 82601  
Fax #: 307-473-2501

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The deadline for submitting applications is **5:00pm, Friday, February 27, 1998**. Resumes will not be accepted in lieu of the application materials. Please call (714) 647-1881 to have an application mailed to you. EOE.

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- 10 ea. PURC 5000 Bases, 900MHz, CSJL51101A
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- 29 ea. MAXTRAC GTX, 800MHz, M1HUG6C81-A
- 5 ea. MAXTRAC, 800MHz, D45ANWASGB7
- 5 ea. MAXTRAC, 800MHz, D35ANWASGB7
- 5 ea. TRAXAR, 800MHz, U35UASG09
- 73 ea. MTX8000, 800MHz, H01UCB6787AN
- 3 ea. MTX800, 800MHz, H25JGB5170
- 2 ea. MTX800, 800MHz, H25JGB5170
- 2 ea. GE TMR, 800MHz, TMR310
- 2 ea. GE TMR, 800MHz, TMR310
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- 1 ea. MICOR Base, 460MHz, C64RCB110SAT
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- 3 ea. GE MASTR II Bases, 460MHz, YC35PAS58B
- 73 ea. SYNTOR X 800, 460MHz, T4AKEJ7J0AAK
- 33 ea. MITREK, 460MHz, T44JJA6009
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- 3 ea. MITREK, 155MHz, T83JJA3000
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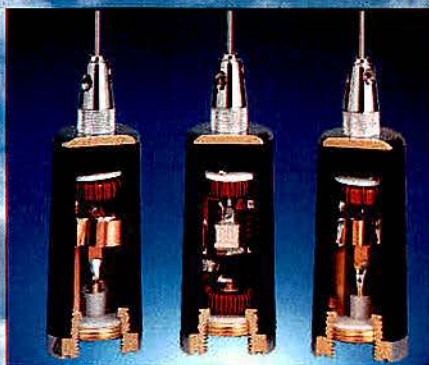
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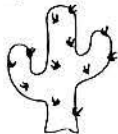


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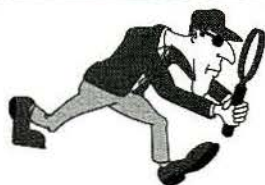
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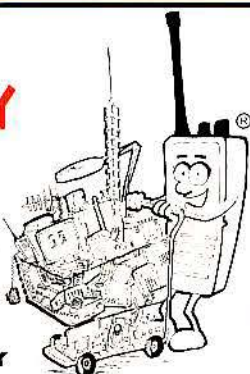
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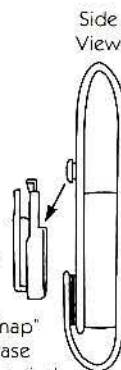
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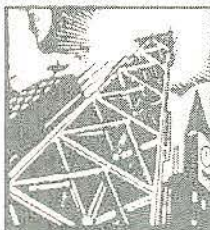
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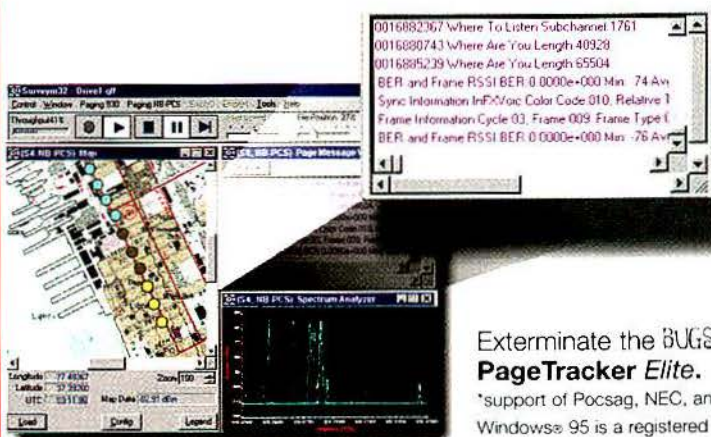




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